ELECTRICAL TIMES

THURSDAY
2 APRIL
1953
NINEPENCE

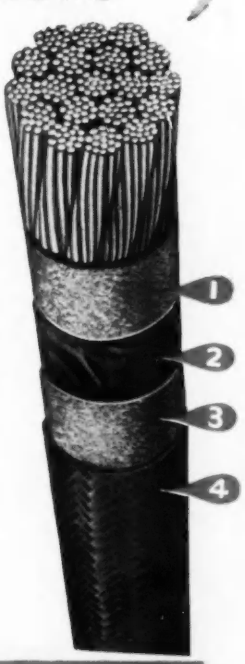
This is the cable for HOT SPOT installations

because

★ . . . the insulation will not burn or carry flames . . .

★ . . . resists moisture, grease, oil and corrosive fumes . . .

★ . . . it is designed to withstand high ambient temperature and overload heating.



BESTOS A.V.C. Cables can save you time, money and maintenance headaches. They're made to withstand *continuous* high temperatures under the toughest working conditions—where other available types of cable would rapidly deteriorate.

See from their construction why they are the obvious answer to Hot-Spot problems.

The Varnished Cambric insulation (2) is protected against high conductor temperatures by an inner layer of asbestos felting (1). Second layer of asbestos felting (3) protects the insulation from ambient heat and oxidation. Tough outer braid of impregnated asbestos yarn (4) gives extra protection against heat, flame, moisture, grease, oil and corrosive fumes.

BESTOS Cables are available in single and multicore types for service up to 6,600 volts. Let our engineers give you further information—or advise you on the best use of BESTOS for your Hot-Spots.

Send for publication No. 318 giving further information on BICC Bestos AVC Cable.

BICC BESTOS
A.V.C. CABLE

BI Callender's

BRITISH INSULATED CALLENDER'S CABLES LIMITED
21, BLOOMSBURY STREET, LONDON, W.C.1

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with

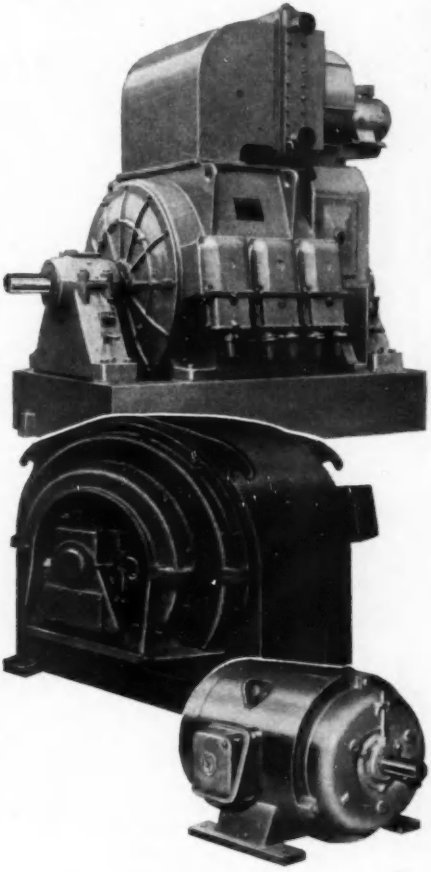
J. & P. Capacitors

To many manufacturers the improvement of the power factor of their electrical installation is probably the easiest way in which they can make an immediate and substantial reduction in their manufacturing costs.

There is no easier nor more reliable method of improving power factor than by the use of J. & P. Capacitors.

May we test your installation and advise you, without obligation, what saving *you* would achieve by the use of J. & P. Capacitors?

T.E., F.C.—in a very wide range



L.S.E. were among the first to make a scientific approach to the problem of cooling totally enclosed motors, and today are able to offer most machines in their range in totally enclosed form.

Motors of small-medium size have a simple "blow-over" cooling system; larger machines have developments of the well-known "EMCOL" principle; and for special conditions (for instance, low speed motors or variable speed motors of wide speed range) heat exchangers, air/air or air/water, can be supplied.

When totally enclosed motors are required, either a.c. or d.c., it is a sound plan to consult L.S.E.

Top: N-S variable speed a.c. motor with air/water heat exchanger (for 1300/326 h.p., 1,100/275 r.p.m. boiler feed pump drive).
Centre: "EMCOL" motor, 600 h.p., 3,000 r.p.m. ("Trislot" type).
Bottom: T.E.F.C. squirrel cage motor (British Standard Dimension type).

LAURENCE, SCOTT & ELECTROMOTORS LIMITED

NORWICH . MANCHESTER . LONDON AND BRANCHES

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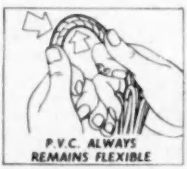
SPEEDFIX **P.V.C.** (Polyvinyl Chloride)

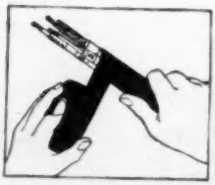
A good insulator and a versatile electrical tape.



1. Thin, strong, pliable. 2. Moulds to shape under tension of application. 3. Tested for insulation at 1,000 V a.c. 4. Resistant to oils, acids and moisture. 5. Withstands weathering and extremes of heat and cold. 6. Does not discolour or corrode copper. 7. Available in colours and also printed.

SPEEDFIX ***INSULATING TAPE***

1. 6 coatings. 2. Pure rubber adhesive only: on BOTH sides. 3 Clean to handle. 4. Does not dry out. 5. No pin holes. 6. Dielectric strength 1,500 V. 7. 2 year storage guarantee on every roll.



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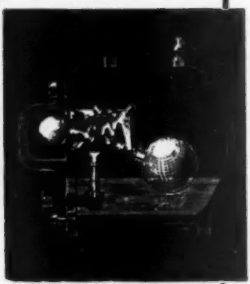

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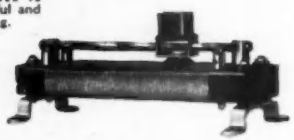

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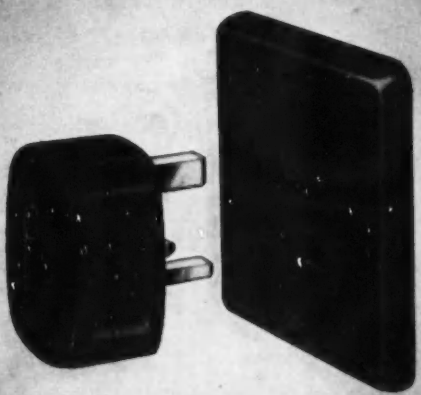

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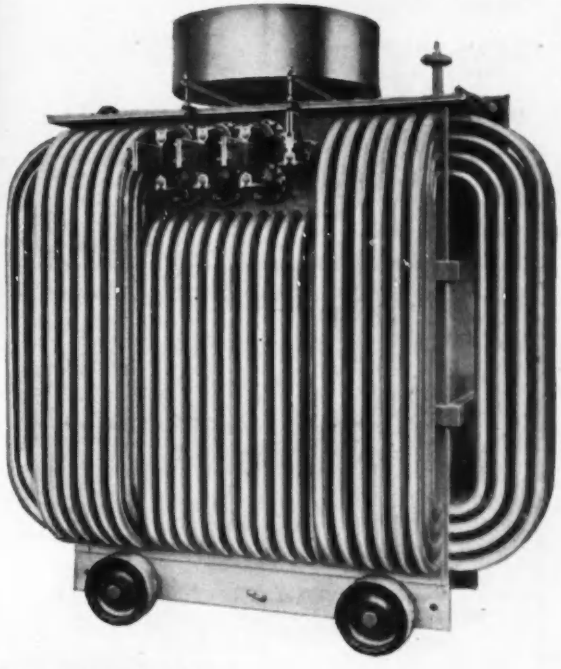

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100 kVA, 3-phase, 50 cycles. Voltage ratio 11,000/50 Delta/Star fitted with off-load switch
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BRIGHT SPOT-AND-HAIRLINE INDICATOR.

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(Patent applied for)

The greatest advance in conduit technique for years

The new ABCON conduit coupling is one of the most important advances that this field of electrical work has seen for many years:—

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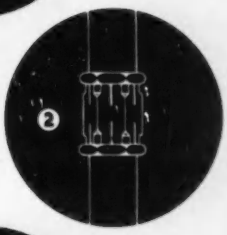
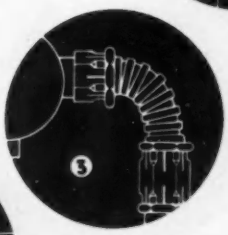
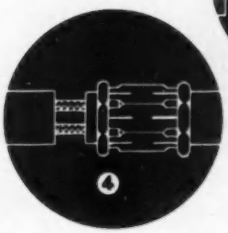
2. For joining rigid to rigid (*no screwing of conduit required*).
3. Supersedes inspection elbows. Sound Bonding.
4. Joints may be opened at any point without dismantling run of conduit.







HOW IT WORKS

Tightening of the taper-threaded nut tightly contracts the slotted end of the ABCON fitting on to the conduit.

JUST SLIDE ON THE ABCON FITTING, TIGHTEN UP, AND THE JOINT IS MADE.

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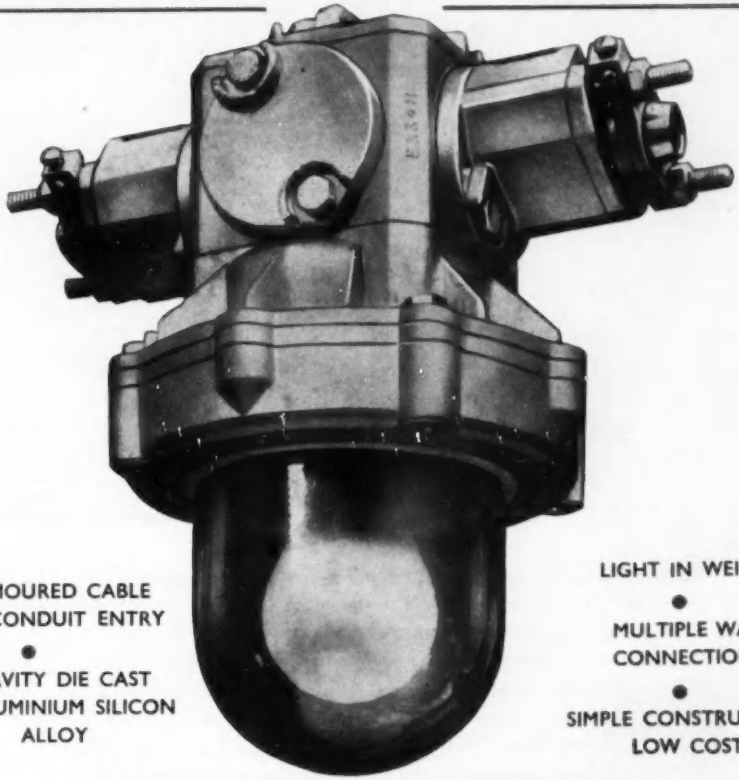
COMPLYING WITH B.S.S. 889 · CERTIFIED FOR GROUPS I, II & III GASES



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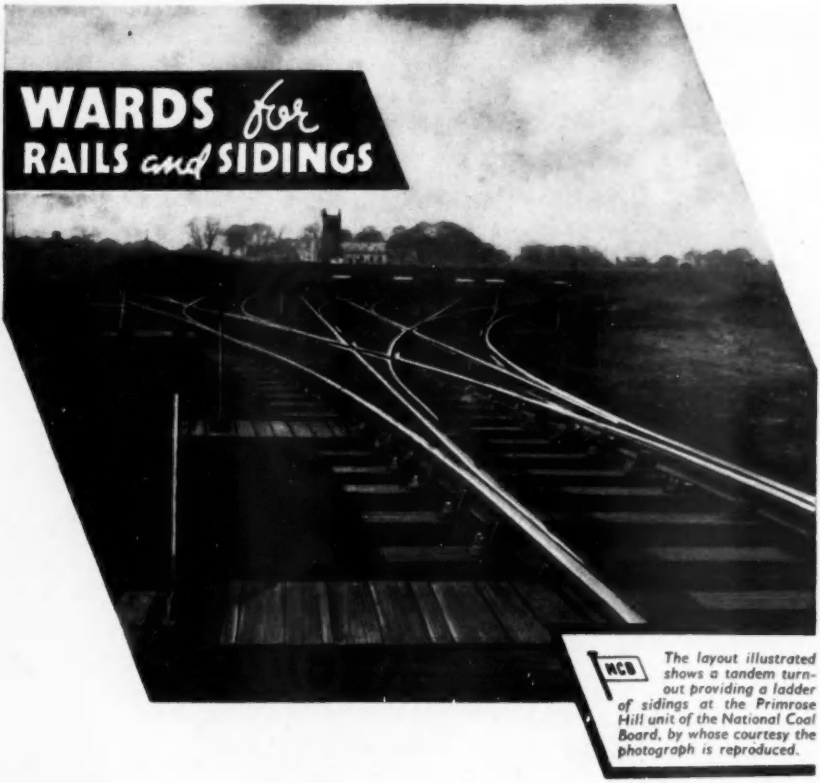

The layout illustrated shows a tandem turn-out providing a ladder of sidings at the Primrose Hill unit of the National Coal Board, by whose courtesy the photograph is reproduced.

Because we take a pride in our undertakings relative to their size and importance, there is a tendency for us to feature our bigger contracts whenever we choose a photograph to illustrate our work. Nobody would gainsay us this very human privilege.

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SC/21

MK75

Squire tells Oi

'Silas' 'e says, 'nip down to Much Kiddling and get new plug.' 'For bath?' says Oi. 'No, for reading lamp' says 'e 'and see it's marked MK.' Now what does 'e want MK on un for. To show it come from Much Kiddling Oi reckon. Wouldn't brag about that, not Oi. Come springtime, Oi calls village Much Kuddling. Young varmints.

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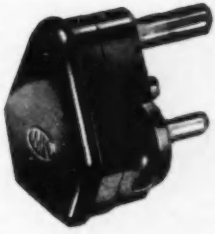

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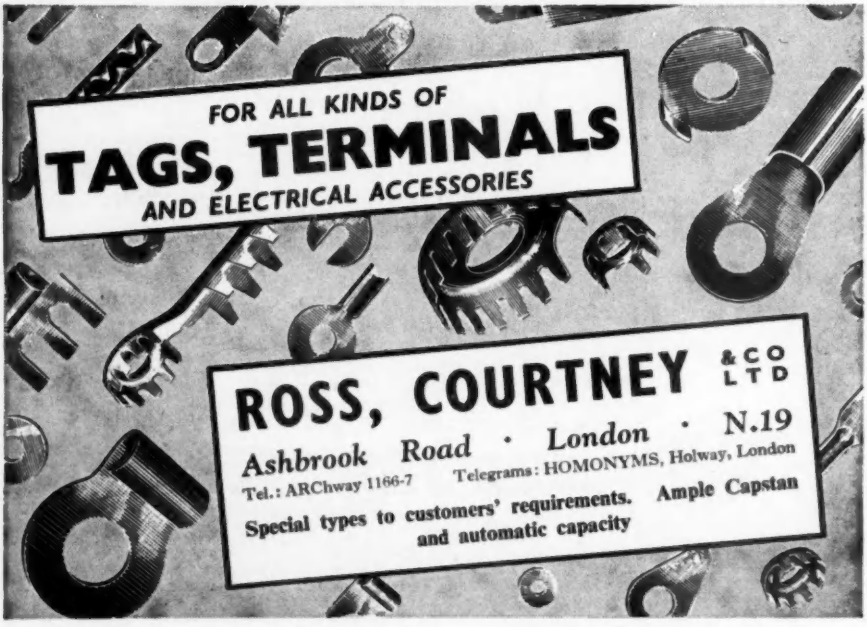
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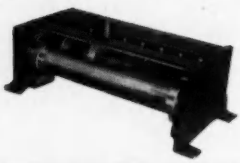
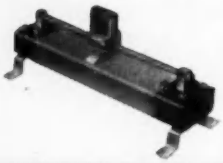
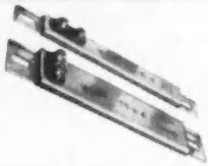


MODEL D.F. TUBULAR RESISTOR



• MODEL O. SLIDING RESISTOR •



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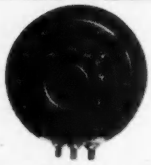
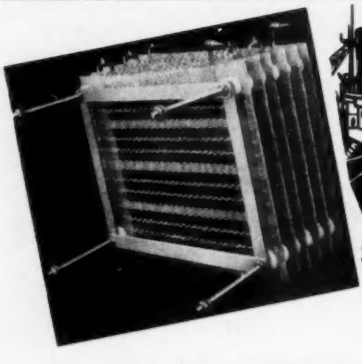


TORROIDAL RESISTOR

CARTRIDGE ELEMENTS



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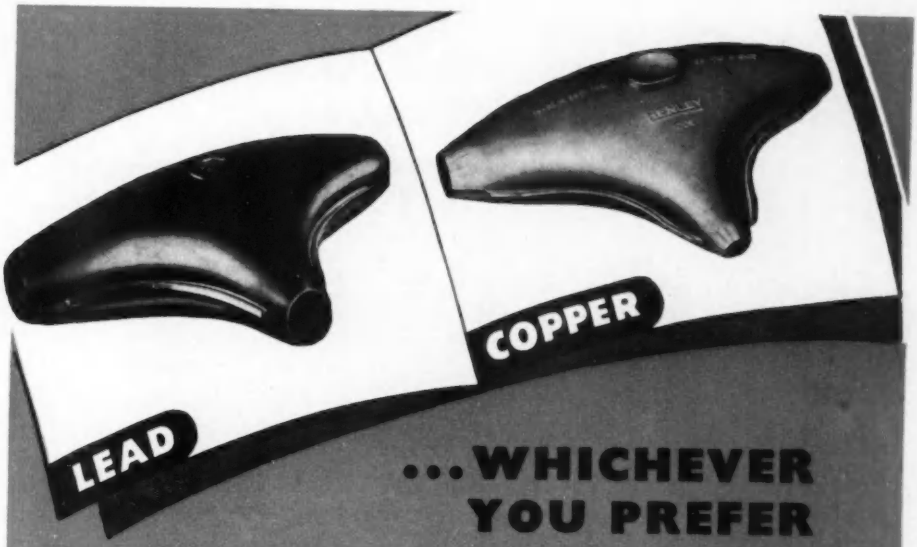

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HENLEY LEAD SERVICE BOXES are pressed from extruded lead sheet. The two halves of the box have specially designed flanges. These form a joint that can be easily wiped, with the minimum amount of plumber's metal, and provide an effective seal. Ample space for jointing. Available in various sizes to take normal main and service cables.

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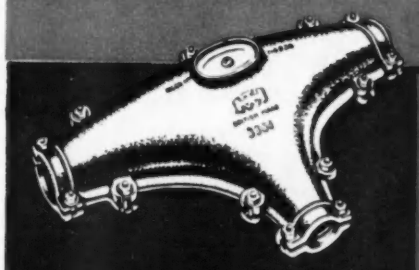
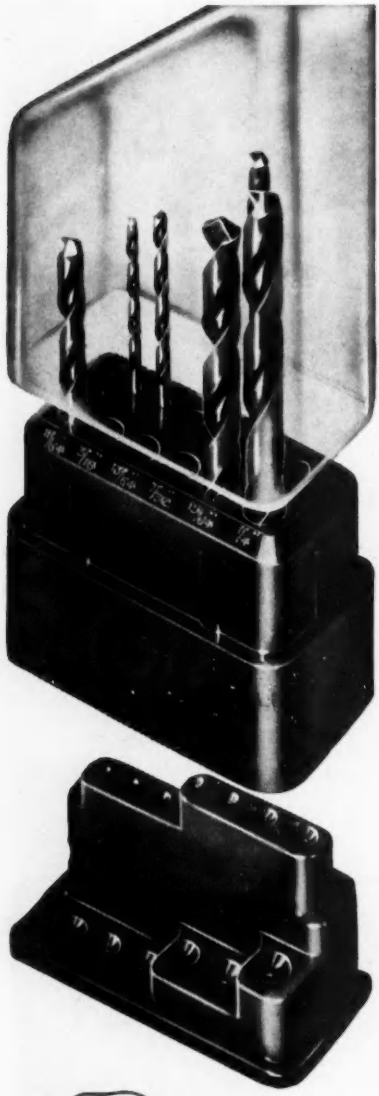
HENLEY
SERVICE BOXES
Write for Catalogue 26



HENLEY CAST IRON BOXES are suitable for use with the Lead or Copper Service Boxes. They provide ample mechanical protection.

W T HENLEY'S TELEGRAPH WORKS CO LTD 51-53 HATTON GARDEN LONDON E C 1



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Try the lively lads there. When they go to work, you get perfect design and service, keen prices and rapid delivery. Their plastic and ebonite mouldings are beautifully finished, and your worries will be too.

This pack for "Easicut" twist drills was produced for English Steel Corporation Ltd., Openshaw, Manchester. The assembly is made up of three separate mouldings: the drill holder, the base and cover. The holder and base are compression moulded in phenolic material. The transparent cover is injection moulded in clear Polystyrene. A phenolic cement is used to assemble the drill holder and base.

LORIVAL PLASTICS

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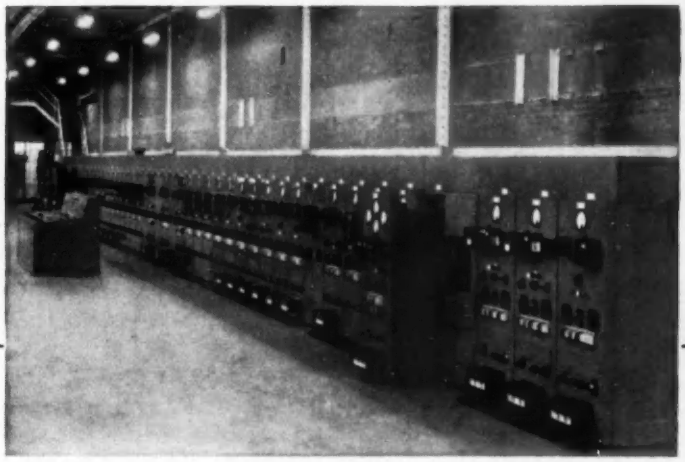
Air circuit breakers at Agecroft Generating Station



'ENGLISH ELECTRIC', pioneers of heavy duty air circuit breakers, have had unrivalled experience in the design and manufacture of this highly specialised equipment.

Designed for indoor use in power stations and by industrial consumers, type OB air circuit breakers are available for medium voltage and 3.3 kV systems. Illustrated is a 46-panel switchboard, incorporating air circuit breakers, type O.B.33L, installed in the Agecroft Generating Station of the British Electricity Authority, North Western Division. These circuit breakers have a maximum rating of 2,000 amps, 3.3 kV and 150 MVA when tested to BS.116 and can be supplied with electrical operation in either single or duplicate busbar versions.

'ENGLISH ELECTRIC'
switchgear

THE ENGLISH ELECTRIC COMPANY LTD., Queens House, Kingsway, London, W.C.2
Switchgear Department, Liverpool

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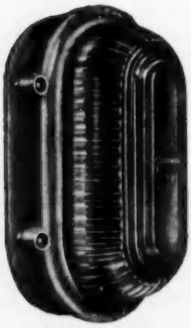
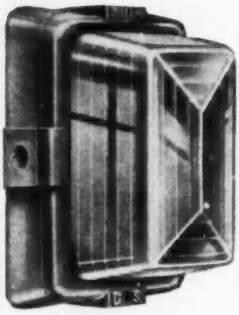
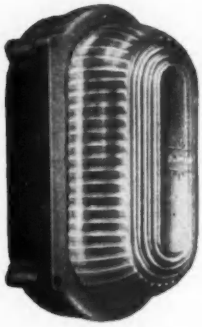


DIOLUX



DIOLUME



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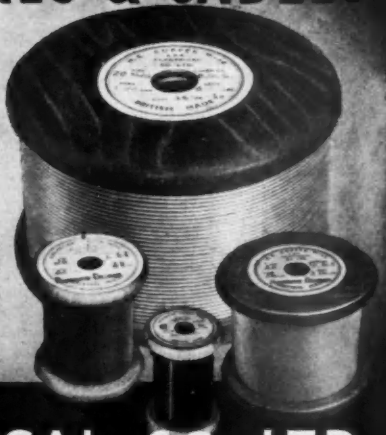

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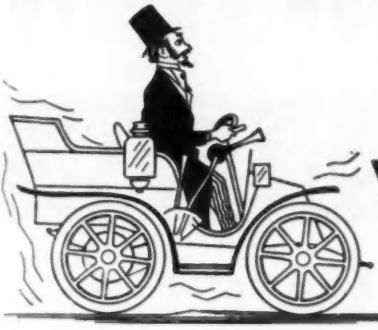

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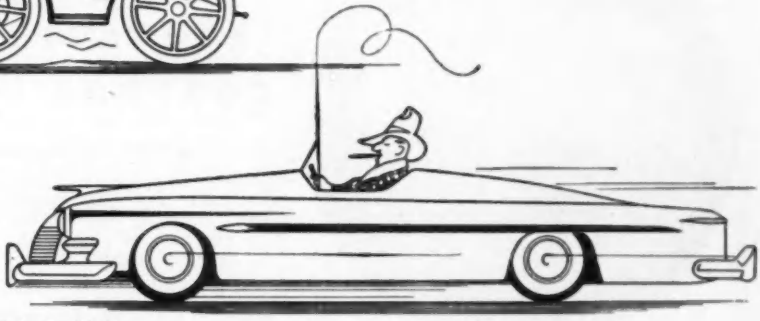

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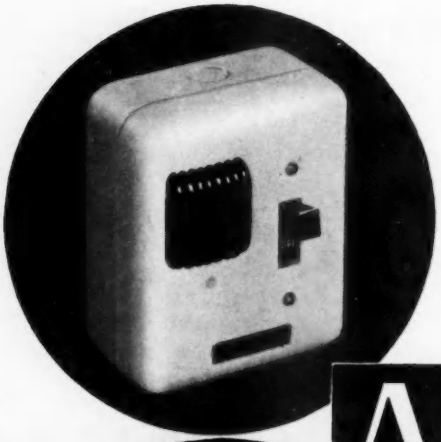

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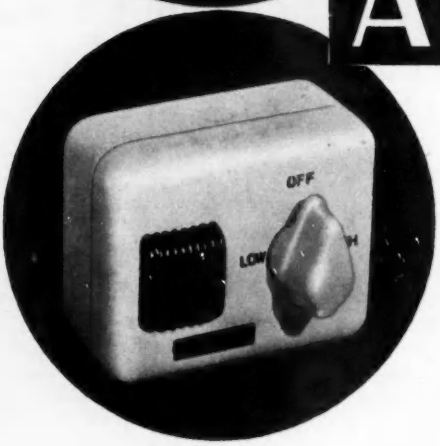

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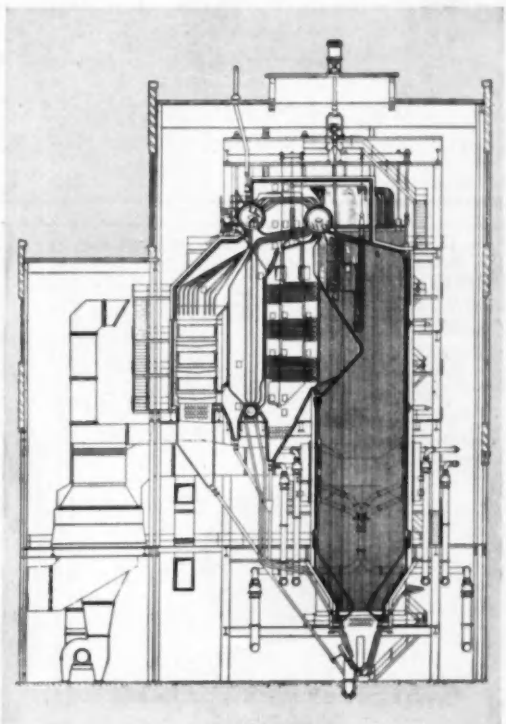

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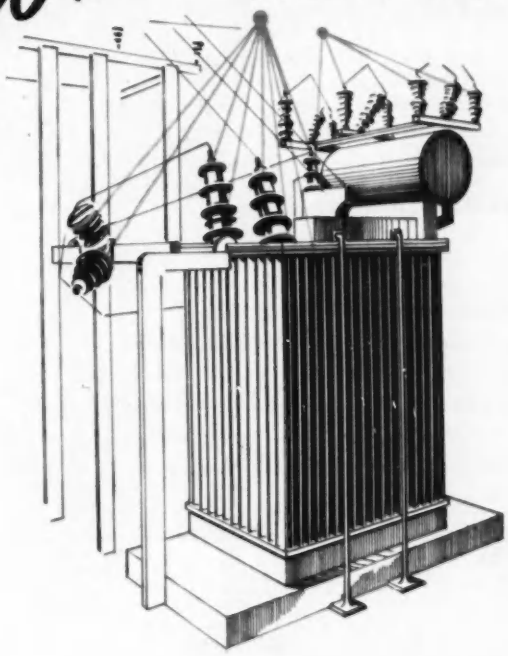

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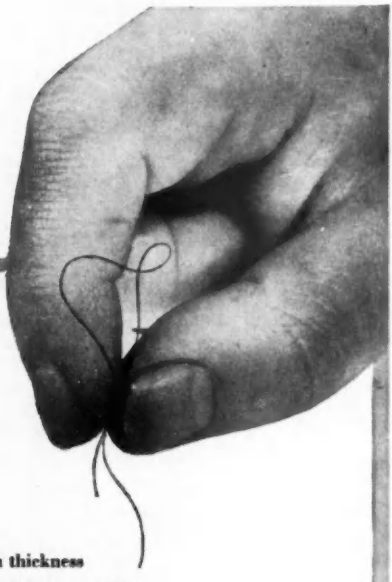

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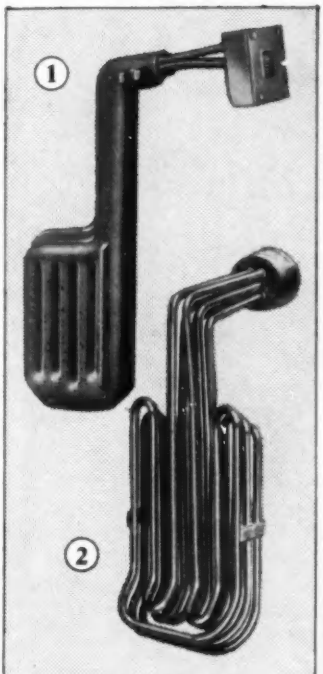
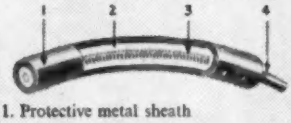


The Heart of the Heater



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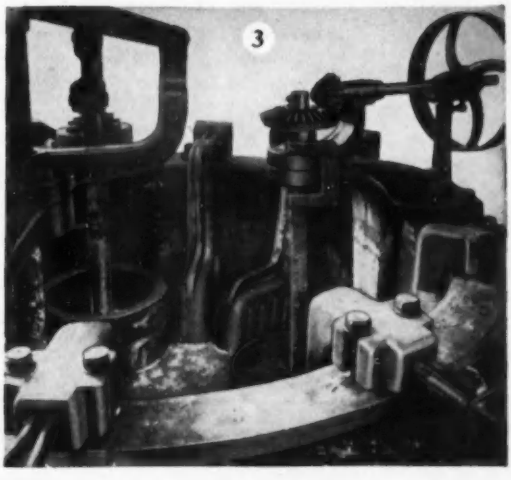

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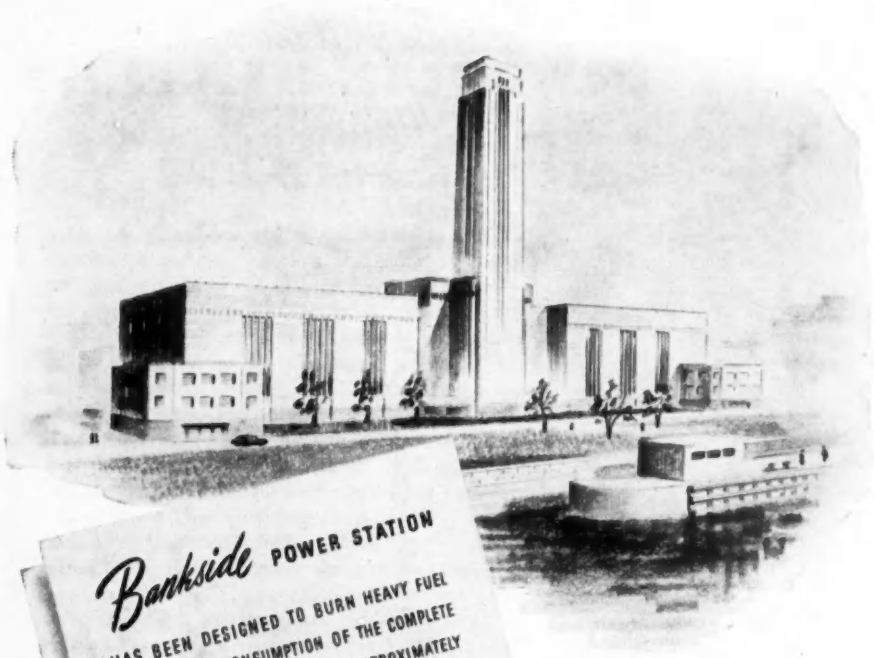

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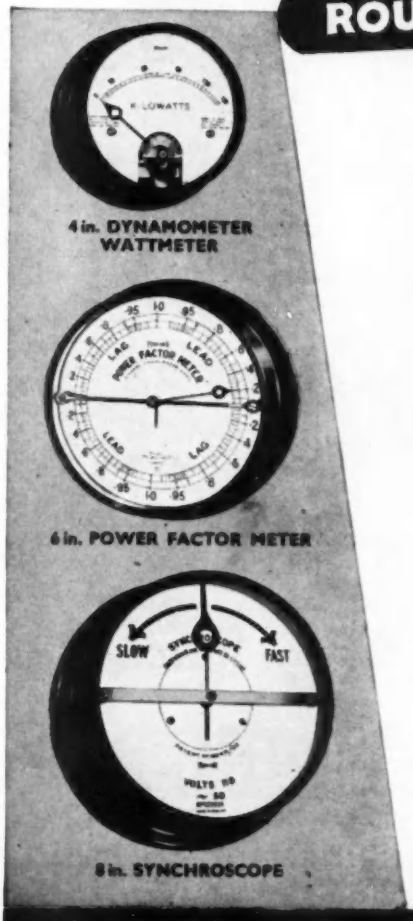

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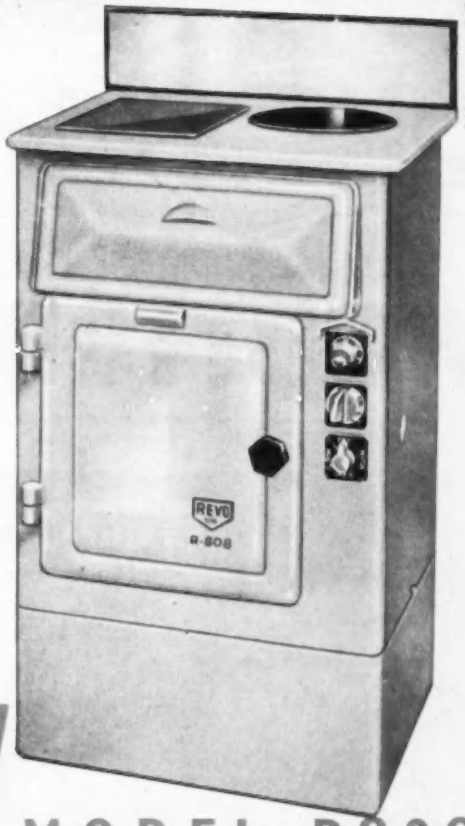

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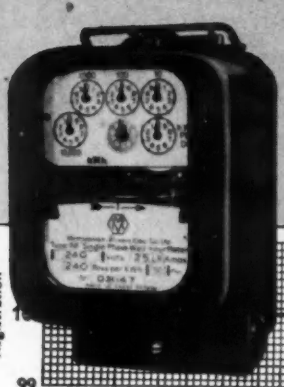

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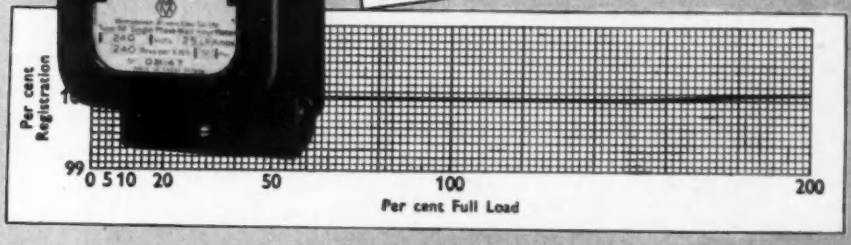
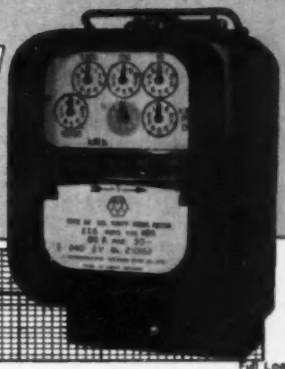
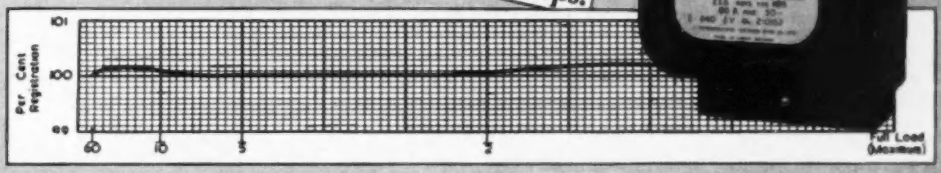


Or to BS 37 (Parts 1 and 2) 1952
in maximum continuous rating capacities of 10, 40 and 80 amps.





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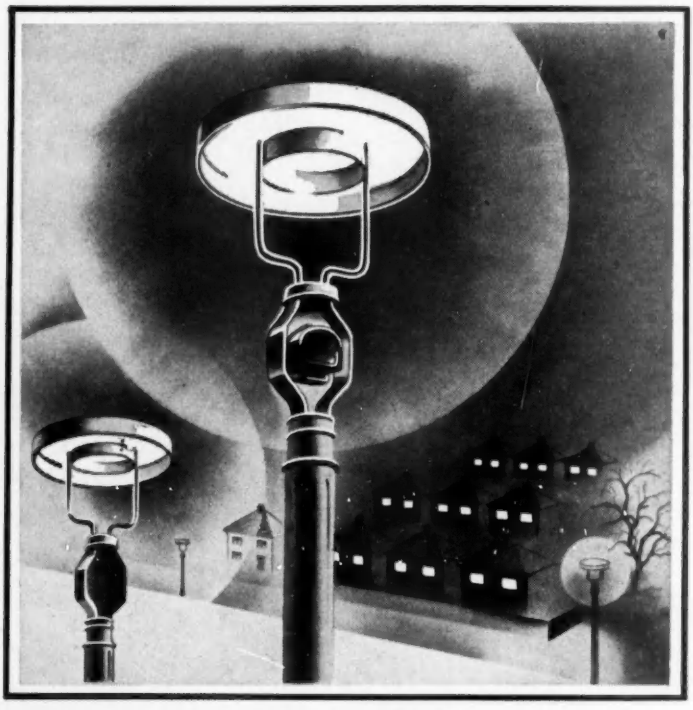

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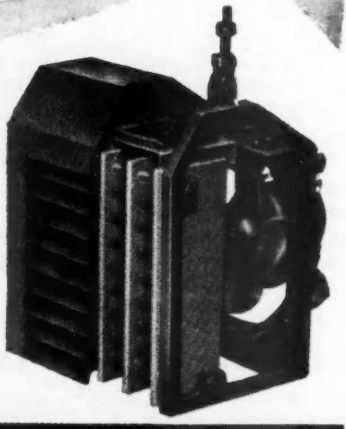

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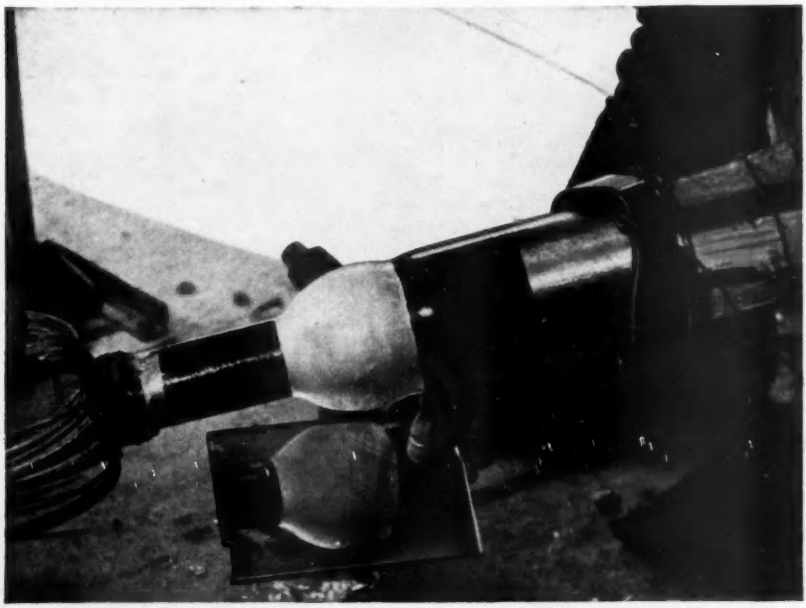

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Volume 123 No. 3204 2 APRIL, 1953

PUBLISHED EVERY THURSDAY

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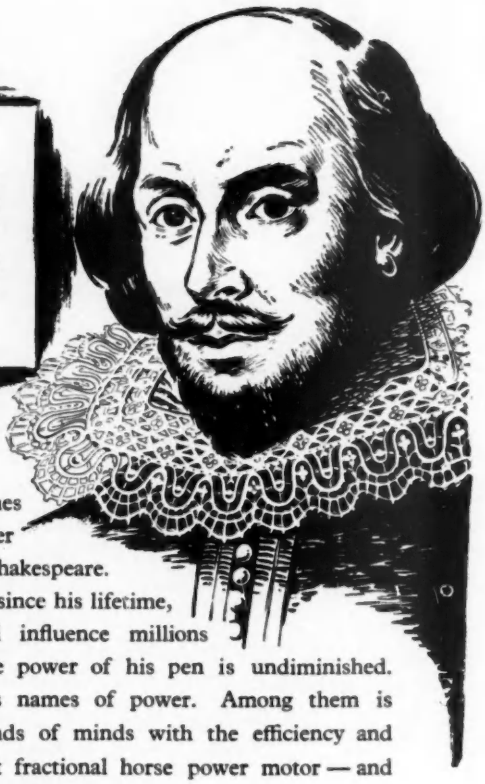
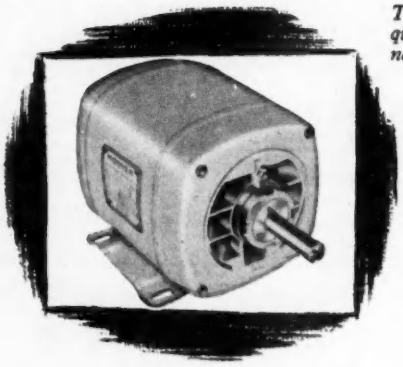


IN HISTORY there are few names which have retained their power as firmly as that of William Shakespeare. Though centuries have passed since his lifetime, his words and wisdom still influence millions throughout the world and the power of his pen is undiminished. Industry, too, has its famous names of power. Among them is Hoover, associated in thousands of minds with the efficiency and reliability of the world's finest fractional horse power motor — and with the service facilities that lie behind it.



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Editorial

FREEDOM TO SPEAK

LORD CITRINE'S forecast, made at last week's EDA/EAW conference, that the frustrating ban on active selling may at last be passing from the electrical scene, will receive a ready welcome from everyone in the industry. True, it was a much-qualified promise of future freedom, and it carried the suggestion that flamboyance would still be frowned on, and expenditure strictly limited. Once the door is opened on a promotional campaign, however, the tempo may be irresistibly speeded. There are many in the industry who have survived the years of frustration with their enthusiasm for the electrical cause unabated; for them an opportunity is coming to put into action four years of pent-up missionary zeal. To them we look for a standard of effort to which the whole industry may aspire, with the active support of those in high places. Two tasks need early attention. Firstly, the public must be persuaded that in spite of the effusions of some misguided but voluble publicists, there is no national sin in using electricity; and then it must be shown how personally satisfying can be the choice of the power of electricity for every task. The unequalled story that can be told should ensure success in this coming campaign for confidence and custom; but throughout the industry there must be displayed an unequivocal faith in electricity.

MEETING THE PUBLIC

IT is unfortunate that the last of the twelve studies in nationalised industries made by the Acton Society Trust should be the least satisfying. Relations with the public is certainly no easy subject since the more subtle lines of approach are not easily discerned. The principal thoroughfare for such relations, the consultative councils, to which some half of the pamphlet is devoted, has, however, been studied, debated, criticised, reviewed so often that the main arguments possess a somewhat jaded air. Of more value is the survey of the function of annual reports of nationalised industries. Although many qualities are found to be wanting therein, the difficulty, as it appears to us, lies in the lack of clear guidance as to precisely what purpose an annual report is to fill; is it intended for experts or is it for reading by the interested lay public? Should it be a bloodless chronicle of facts or a spirited account of achievement? Until an answer is found, if indeed there be one, no doubt annual reports will continue to be very much the individualistic compromise they have been hitherto. Of the many points raised in the section on information services, space permits mention of only one, the need for better understanding of the consumer's viewpoint. The suggestion of the use of market research to this end appears to have only limited application to questions of electricity supply, since primarily the public's needs are simple: first a supply of electricity, and secondly that it shall be cheap. If there be an application it must surely lie in the sales of consumer appliances and it is no doubt, in this field, that the gas market research department is most active. Finally, it is only fair to say that in criticising this last pamphlet we have chosen as a criterion the earlier Acton Trust publications. Taken together, this series provides an outstanding study of the many factors to which nationalisation has given rise; it is one which deserves study by every senior officer of corporate organisations.

We join with readers in expressing the deepest regret at the passing of H.M. Queen Mary and we extend our sympathy to the Royal Family

VOTE OF THANKS

MR. THOROGOOD has done it again. With meagre resources but a great deal of courage, he has organised an exhibition that the electrical industry finds, rather to its surprise, it has long been wanting. We confess that a year ago, we had our doubts whether it was possible for him to repeat his success of 1952, but we are very happy to find ourselves now congratulating him, his willing helpers and the A.S.E.E., on another resounding success. In the wide spaces of Earls Court, the exhibition has preserved its welcome characteristic of readily available technical information which made its Horticultural Hall debut so outstanding, and there can be no doubt that electrical manufacturers owe a considerable debt of gratitude to Mr. Thorogood and those associated with him for their foresight, enterprise and enthusiasm. Yet the need for serious consideration of the future of the exhibition remains. The early announcement that the A.S.E.E. intends to sponsor next year's event is a courageous step, but surely more than this is needed to ensure that the industry gains the maximum benefit from its own exhibition. But whatever structure is evolved, it must be capable of maintaining the special character of the exhibition while keeping its cost attractively low.

COMMON CARE

ELECTRICAL accidents in 1951, as listed in the latest Factory Inspector's report, are at the lowest total since before the war. With an increased working population engaged in factories and with the use of electricity expanding more rapidly, this is a not unsatisfactory result. Yet when the analysis of the accidents presented in the report is studied, it is impossible not to be distressed at the ease with which most of them could have been avoided. If eye-flash in welding is excluded, more than one-third of all accidents—and half of those proving fatal—are found to occur on portable apparatus, which is so frequently noted as needing specially careful attention. Over one-quarter of all accidents involving electric shock were made worse by a faulty earthing system; and there were 31 accidents involving portable test sets, including the popular improvised test lamp. There are noted in the report complicated sets of circumstances, and unpredictable technical coincidences which have led to accidents: but for the greater number of accidents it is the simple things that have gone wrong—portable appliances not properly maintained, earthing arrangements not checked, test gear used thoughtlessly. That is the tragedy. Safety calls not for cleverness, but only common prudence and common sense.

STATIC INTO ACTION

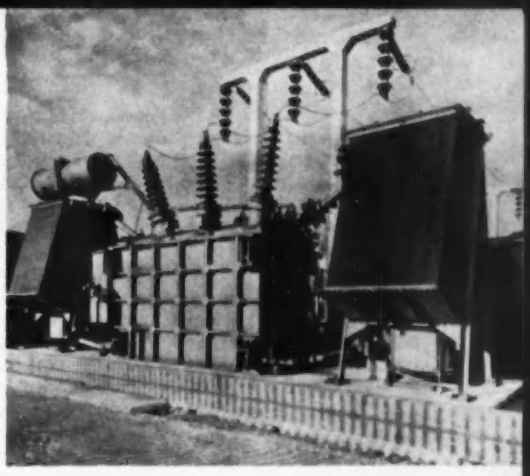
FOR most electrical engineers, static electricity is rather a theoretical subject, thankfully abandoned at an early stage in their technical studies. The attitude is understandable, for there has been little practical application of this form of energy until recent years, but more recently the picture has changed rapidly. A knowledge of electrostatic principles has become necessary to promote safety in factory and hospital; nuclear and X-ray developments have depended on electrostatic generators; and some production processes have been evolved which depend directly on electrostatic forces for their successful working. This growing importance has given rise to an impressive amount of research into the fundamental phenomena involved, and the time was clearly ripe for a conference such as the Institute of Physics held in London last week. This provided the setting for a comprehensive summary of prevailing knowledge and theories, and there can be no doubt of its interest and usefulness. In particular, it has shown how many of the widely accepted ideas of the past were incorrect, with confusion between the effects of contact and frictional voltages impeding the development of fundamental theories. Electrostatic electrification is still as difficult a subject for experiment as in those remembered days of lectures and the gold leaf electroscope; but the rate of progress is accelerating, and compact machines are being developed which will take electrostatics into everyday use.

Meteor

2 APRIL, 1953

Magnetising Inrush Currents in Transformers

By K. W. E. GRAVETT, M.Sc.(Eng.)



WHEN a transformer is switched into circuit a transient magnetising current will flow until normal conditions are established in the core. In the majority of cases this current is of little importance, but under certain conditions it may instantaneously reach a value many times in excess of transformer full load current. High switching-current surges cause protective gear to operate and may cause voltage dips over the whole system and, in severe cases, the stalling of loaded industrial motors. It is this nuisance aspect of inrush currents which is important rather than the possibility that damage may be caused to the transformer itself.

Early Importance

This question first arose in conjunction with Dr. Ferranti's mains from Deptford to London; the transformers were subject to mysterious failures at the moment of switching on, even though they had previously operated successfully. Professor J. A. Fleming was asked to investigate and, in an appendix to his paper on "Alternate Current Transformers" in 1892, described this phenomenon. With the advent of the oscillograph, later papers, notably by Jensen, were able to show the effect more clearly. A recent revival of interest may be attributed to the development of cold-rolled, grain-oriented core materials, which may be operated at a higher value of flux density, under which conditions these effects will be more marked.

Consider a series circuit consisting of an air-cored inductance and a small resistance. When a sinusoidal voltage is switched on to this circuit, the instantaneous voltage applied will depend upon the position in the voltage cycle where switching has occurred. Since the current is initially zero, this voltage is instantaneously opposed only by the back e.m.f. produced by the inductance and proportional to its rate of change of flux.

Now, supposing the core is demagnetised and the voltage applied as it is passing its maximum, the initial value of the rate of change of flux must be a maximum. This corresponds with a value of flux passing through its zero (i.e. lagging 90° behind the voltage). This is approximately the position in the steady-state and thus in this case no transient will occur. Again with the core demagnetised, suppose that the sine wave of voltage is switched as it is passing through zero. In this case the instantaneous value of the rate of change of flux must be zero; but this can only occur when the flux itself is at either a maximum or minimum position. The core is, however, initially demagnetised and thus to obtain this condition the flux waveform is displaced bodily, so that it oscillates between zero and twice the maximum steady-state value. Due to the resistive losses in the circuit, the flux does not quite reach double magnitude and slowly becomes symmetrical about the time axis. Thus initially, magnetisations of the order of double value are periodically produced in an inductive coil, and it will be appreciated that if this coil represents a transformer winding, with a saturable core, the current corresponding to this high magnetisation is often considerably more than doubled.

Remanent Magnetism

The above two examples are limiting cases, the effect of switching at random angle being intermediate between them. With the consideration of remanent magnetism a further four possible cases are apparent. This will only affect the flux wave and not the rate of change of flux required. Thus it has the effect of displacing the flux waveform. For switching at the point of zero voltage, with residual magnetism opposite to that which the transformer

would have had at that instant in the steady-state, the maximum possible flux density is three times normal, while residual flux of the same direction as the flux would have had in the steady-state will reduce the transient displacement.

A further two critical cases occur when switching at the point of maximum potential, with again the possibility of remanence in either of two polarities. In each case a transient component of flux is produced, giving a limiting value of twice normal flux in a direction determined by the polarity of the residual.

These examples, which consider remanent magnetism in the core are important, as in practice an oil switch usually interrupts the circuit at a current zero, thus almost invariably leaving maximum residual flux. This does not decay with time and is little affected by mechanical vibration. Thus, if a circuit is closed at 0°, either a very heavy transient or none at all is possible. Neither of these are likely, but switching at any other instant is bound to cause a transient and the probability of a current rush occurring is high.

So far a single-phase transformer has been considered. The above remarks apply to the three-phase unit provided each phase is considered in its correct switching angle sequence. Obviously it is not possible to switch all three phases at their most favourable positions in the cycle, and thus some transient must occur.

Effects on Transformer

Before carrying out any calculations, it is interesting to consider what effects the surge currents may have on the transformer being switched. Tremendous mechanical forces will be produced by the momentary high currents, but these will not exceed those caused by a through short-circuit, for which the transformer should have been designed. The heating effect of these currents is also negligible, as they are normally of only short duration. Shifting of the magnetic axis into a region where bolts or other solid parts exist may cause eddy currents and consequent local heating. In general, however, the effect on the transformer being switched is negligible.

The flux waveform may be considered as containing a direct component in addition to the alternating component. The maintaining current also has a direct component, which due to non-linearities no longer decays exponentially. This direct current is usually derived from the power system to which the transformer is connected. However, if it is connected in parallel (on the primary side) with another transformer already in circuit and the supply impedance is high, the direct current may circulate between the two primary wind-

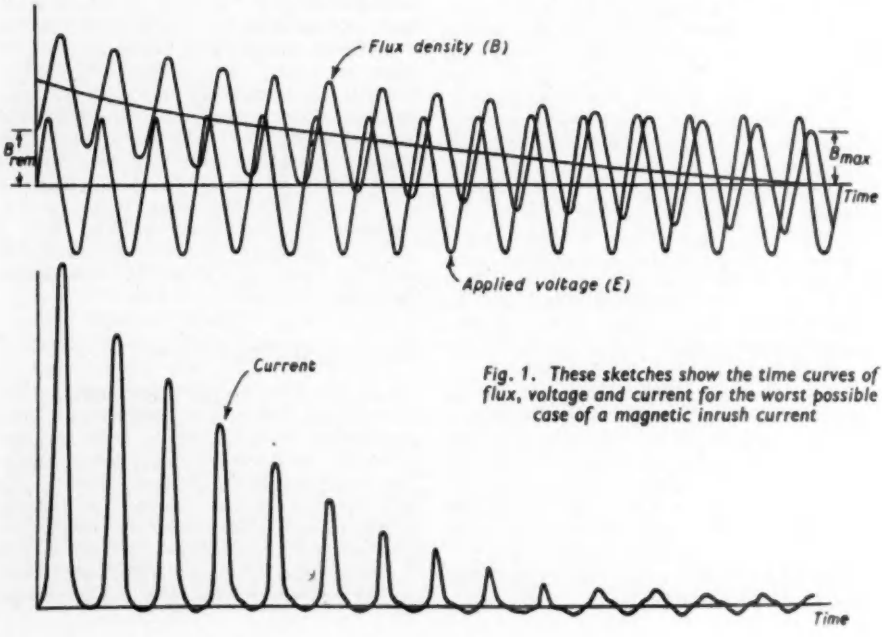


Fig. 1. These sketches show the time curves of flux, voltage and current for the worst possible case of a magnetic inrush current

ings. This current causes saturation in the transformer already in circuit and produces a considerable transient current similar in form to an inrush current, but of opposite sign, occurring on the other alternate half cycles. These transients will last much longer than those due to switching one transformer alone, since the resistance of the two primaries is much less than the supply impedance and thus does not cause such rapid decay. In this case the load carried initially does not appreciably affect the transient current, which is very sensitive to the total resistance of the two primaries. A small increase in this provides the best cure for this condition.

Calculation of Transient

The current flowing when a sine wave of voltage is applied to a series circuit consisting of an inductance and a resistance is given by:

$$n.\frac{d\varphi}{dt}10^{-8}+i.R=E.\sin(\omega t-\alpha) \quad \ldots.(1)$$

where i = instantaneous current (amps).
φ = instantaneous flux (lines).
n = number of turns.
R = total circuit resistance (ohms).
E = amplitude of sinusoidal applied voltage.
ω = angular frequency.
α = electrical angle at which switching occurs.

This differential equation does not lend itself to general solution, a result only being possible for certain simple relationships between flux and current. If the coil is air-cored the equation becomes:

$$L.\frac{di}{dt}+iR=E.\sin(\omega t-\alpha) \quad \ldots\ldots\ldots\ldots.(2)$$

where L is the coil inductance.

This has the solution:

$$i=\frac{E}{\sqrt{R^2+\omega^2L^2}}.\sin(\omega t-\alpha-\psi)+\frac{E}{\sqrt{R^2+\omega^2L^2}}\varepsilon^{-\frac{Rt}{L}}.\sin(\psi-\alpha)\ldots\ldots(3)$$

In this expression the first term represents the steady-state current, determined in value by the impedance and of phase angle ψ, given by:

$$\tan\psi=\frac{\omega L}{R}$$

The second is a transient term of initial magnitude depending upon the angle of switching and subject to an exponential decay of time constant L/R. Two cases are of immediate interest.

When $\alpha=\psi$, $\sin(\psi-\alpha)=0$ and no transient occurs. If the resistance is small compared

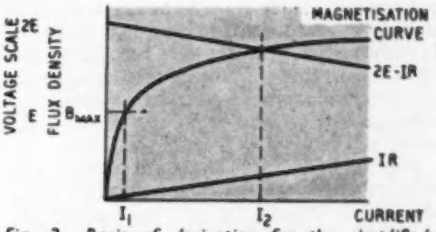


Fig. 2. Basis of derivation for the simplified formula for inrush current magnitude

with the inductance, ψ is approximately 90°, confirming our contention that switching at 90° gives no surge. When $(\psi-\alpha)=90°$, $\sin(\psi-\alpha)=1$ and the transient term is maximum. This corresponds to switching at the point of zero pressure. In this case the transient term becomes:

$$\frac{E}{\sqrt{R^2+\omega^2L^2}}\varepsilon^{-\frac{Rt}{L}}$$

This has decayed but little by the time the steady-state current has reached its first maximum, and thus under the worst switching condition the current through an air-cored coil reaches a value almost double its peak in the steady-state.

It is interesting to note that, provided the flux density remains constant, the higher the frequency, the smaller will be the time to reach the first peak and hence the nearer the maximum current will approximate to double value. It is often quoted in early papers that in testing transformers at higher frequencies, the current surges disappeared. In this connection the testing took place at constant voltage, the small effect of frequency being entirely masked by the consequent reduction in flux density.

Iron Core

When an iron core exists it is necessary to return to the fundamental equation (1) and for its solution some relationship must be found to represent the magnetisation curve of the coil. It is possible to assume that, as the resistance is small, the error in making the substitution:

$i=\frac{n\varphi.10^{-8}}{L_m}$, where L_m is a fictitious mean inductance, is also small. The equation may then be solved for flux, and the equivalent maximum current found from the actual magnetisation curve.

This may be extended by considering the magnetisation curve as composed of two straight lines, representing the normal and saturated regions. Such is quite common

practice in the study of magnetic amplifiers and transducers. Exponential expressions may also be used and calculations have been based on these types. However, already the complexity of the calculations is sufficient to deter the practical engineer, and on grounds of practical, utility will be rejected.

It is interesting at this stage to consider the effect of switching a loaded transformer. This, the author believes, is contrary to normal practice on power systems, and it seldom occurs in communications equipment because of the heating time of thermionic rectifiers. It is, however, important to note that the existence of a closed secondary circuit does not prevent inrush currents. Nevertheless, under transient conditions a resistive load, due to the extra voltage drop temporarily caused in the primary circuit resistance, slightly reduces the maximum effective flux reached and thus also the current surge. It is noted that in practice any amelioration would be small. Inductive and capacitative loading have a similar effect, with the possibility in the latter case of ferro-resonance.

Eddy Current

In the calculations so far used no consideration has been given to eddy current or hysteresis losses. Eddy currents undoubtedly exist in the core windings and supports of a practical transformer. In all of these calculations they will be neglected. This may be permissible as, for a lamination of normal thickness at power frequency, at the instant of maximum excitation practically no eddy current exists. In this work, however, it is sufficient to observe that the eddy currents may be considered as replaced by a closed damping ring, which, since such losses are reduced to a minimum in a practical design, would be of comparatively high resistance. This would be equivalent to a small load taken from the transformer, and may be referred to the primary as a high resistance in parallel with the exciting winding. The voltage drop in the primary source impedance, due to the current through this, is negligible, and thus the existence of eddy currents may be ignored on a consideration of the magnitude of their influence alone.

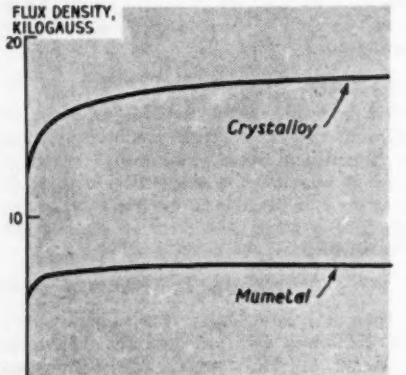


Fig. 3. Magnetisation curves for the model transformers on which the theories developed were tested

Step-by-Step Solution

Hysteresis has been neglected in analytical work, since no suitable expression has been evolved to allow for it. It may be considered in a step-by-step method first developed by Yensen. This considers the important parameters involved and gives a full plot of the current waveform. The agreement obtained between calculated and practical results is remarkable. The disadvantage lies in the impossibility of obtaining a general solution, a fresh plot being required for each set of boundary conditions, the time involved being excessive. It is, nevertheless, worthy of further consideration. The equation to be solved is:

$$\frac{n.d\varphi.10^{-8}}{dt}+i.R=E.\sin(\omega t-\alpha)$$

Let $\theta=\omega t-\alpha$, then $\frac{d\theta}{dt}=\omega$

Let A_c be the cross-sectional area of the iron of the core (cm²), B be the instantaneous flux density in the core.

Then:

$$\frac{n.A_c.dB.10^{-8}}{dt}+i.R=E.\sin\theta$$

$$dB=\frac{E}{\omega n.A_c.10^{-8}}.d(\cos\theta)-\frac{i.R}{\omega n.A_c.10^{-8}}.d\theta$$

but $\frac{E}{\omega n.A_c.10^{-8}}=B_{max}$, the maximum value of flux density in the a.c. cycle. Hence:

$$dB=B_{max}.d(\cos\theta)-\frac{i.R.B_{max}}{E}.d\theta$$

Replacing differentials by differences:

$$\Delta B=B_{max}.\Delta(\cos\theta)-\frac{i.R.B_{max}}{E}.\Delta\theta \quad ..(4).$$

Starting at the requisite switching angle with remanent flux density B_{rem}, calculations are made for small increments of angle. For each value of flux density the corresponding current is read off either the magnetisation curve or

preferably a nest of hysteresis loops, the resistance drop calculated and the value of flux density corrected. This process rapidly converges, and by repeating this it is possible to plot curves of flux density and current for several cycles, the only limit being the time and labour involved.

Empirical Solution

Since rigorous methods of solution appear so time-consuming that they are of little use to the practical engineer, it is worthwhile to consider a semi-empirical equation which has been formulated by Blume. This assumes that the maximum flux density which iron can add to a given magnetic field is limited (to approximately 20 kilolines per sq cm). Any additional increase in flux, once this value is reached, must take place in the air space enclosed by the windings.

Let B_{sat} be the maximum flux density which the core material can add to the magnetic field.

B_{rem} be the remanent magnetism existing in the core when the transformer is switched.

B_{max} be the normal steady-state maximum flux density. (All in kilolines/cm².)

A_w be the area of a mean turn of the magnetising winding (cm²).

h be the effective height of the magnetising winding (cm).

Under transient conditions, the flux density reached in the iron is B_{sat}.

The flux density in air is $\frac{A_c}{A_w}(2B_{max}+B_{rem}-B_{sat})$

The ampereturns necessary to produce this density in air is so large that the ampereturns in the iron may be neglected. Hence, maximum possible instantaneous current is:

$$\frac{10^4.h.A_c.(B_{rem}+2B_{max}-B_{sat})}{4\pi n.A_w} \quad \ldots\ldots\ldots\ldots (5)$$

This result neglects circuit resistance and thus gives an upper limit to the possible current inrush.

A lower limit for the peak current may be found by considering the effect of resistance in the following manner, which is best explained by reference to Fig. 2. On this a magnetisation curve may be drawn with co-ordinates of flux density and current, the latter bearing a fixed relationship to the magnetising force, depending upon the winding,

$$H=\frac{4\pi.n.i}{10\ h} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

If it is assumed that the voltage applied is sinusoidal and of amplitude E, and that the resistance in circuit is insufficient materially to prevent the steady-state flux waveform from being sinusoidal, then the peak values of voltage and flux density are related.

$$E=2\pi f.A_c.B_{max}.n.10^{-8}=(\text{constant})\times(B_{max}) \quad \ldots (7)$$

The value of this constant depends on the dimensions of the core and winding. Given this constant it is possible to construct a vertical scale of voltage to which the magnetisation curve will correspond, provided it is appreciated that the voltage is peak voltage and that the relevant current is the peak current, and that this construction only applies for the peak values and not at any other instant of time.

Having a scale of voltage and a scale of current, it is now possible to represent the circuit resistance by a straight line through the origin with slope equal to the resistance. Since in the steady-state the resistive drop is negligible, the intercept of a horizontal line through B_{max} (or E) with the magnetisation curve gives the steady-state peak current I_1.

We have shown above that the flux density tends to double in the transient state. That it does not do so is due largely to the resistance

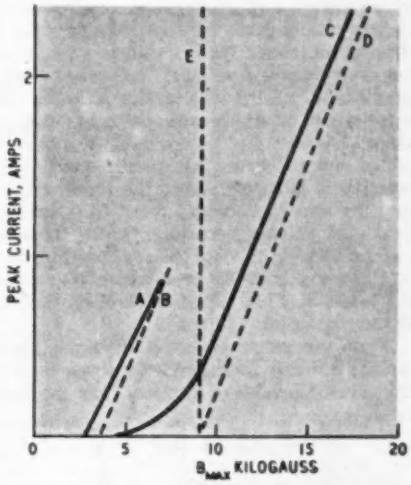


Fig. 4. Specimen results obtained from model transformers of the materials noted below

Curve	Material	Subject
A	Mumetal	Actual results
B	Mumetal	Lower limit from equation 8
C	Crystalloy	Actual results
D	Crystalloy	Lower limit from equation 8
E	Crystalloy	Upper limit from equation 5

of the circuit, and to obtain an approximation to the peak current experienced the resistive drop is subtracted (to the voltage scale) from the double applied voltage. This may be done graphically by drawing a line $2E-iR$, the intersection of which with the magnetisation curve giving a value of current I_2. It should be stated immediately that such direct subtraction is fallacious, since the resistive drop and the applied voltage are not in phase, the peaks of voltage occurring before those of current. However, since the ameliorating effect of resistance cannot be greater than in this case, the result obtained represents a lower limit to the current peak value.

From this graphical method it is possible to deduce a simple formula for the lower limit to the maximum value of transient. For the point of intersection:

$$2E-iR=k.B=k.\left(B_{sat}+m.\frac{A_w.i}{A_c}\right)$$

where $k=\frac{E}{B_{max}}=2\pi f.n.A_c.10^{-8}$

and $m=\frac{4\pi.n}{10\,h}$

Hence $2k.B_{max}-i.R=k\left(B_{sat}+m.\frac{A_w.i}{A_c}\right)$

Thus, allowing for remanent magnetism,

$$I_2=\frac{20.\pi.f.n.A_c.h.10^3.}{10^9.R.h+8\pi^2.f.n^2.A_w}\left(2B_{max}-B_{sat}+B_{rem}\right) \quad \ldots\ldots(8)$$

or if the bracket is negative the current is assumed zero. It is interesting to note that this equation reduces to equation (5) above when the resistance is zero. These two formulae give upper and lower limits within which the peak current will lie.

Results with Model Transformers

As the power which could be expended in the laboratory was limited, it was not possible to verify the theoretical considerations outlined above with full-size power transformers. Instead model transformers were used and these were initially in the form of toroidally wound, clock-spring cores of Mumetal and Crystalloy. The dimensions are given in Table 1 and the magnetisation curves for these materials in Fig. 3. As the primary resistance of these specimens was approximately 6 ohms, the total circuit for the example in Fig. 4 being 14 ohms, they represent a very high resistance case, imposing a good test of the formulae developed in the previous section. Because of this, the discrepancy between the upper and lower limits as given by equations (5) and (8) is large, whereas in the majority of practical cases it will only be of the order of 10%.

Oscillograms of current and voltage were obtained with a Duddell oscillograph, which gave the results as photographic records. This instrument inherently measures current, the elements themselves consisting of permanent magnet, moving coil galvanometers of low inertia, the coil reduced to a single-turn loop to which the mirror is attached. In the instrument in use natural frequency was of the order of 10,000 c/s per sec., allowing a considerable number of harmonics of the power frequency to be faithfully reproduced.

TABLE 1. DIMENSIONS OF MODEL TRANSFORMER CORES
All have toroidally wound, clock-spring cores.

Nominal outer diameter	3¼ in.
Nominal inner diameter... ...	2⅜ in.
Strip width	½ in.
Strip thickness—Mumetal	0·008 in.
Crystalloy	0·016 in.
Windings—primary turns	800
secondary turns	120 0-10-50-100

The angle of switching in the a.c. cycle has been shown to be critical, and thus it had to be carefully controlled to give consistent results. The switching was carried out by a Carpenter relay, controlled by a synchronous motor-driven contact-maker. This relay was applicable, since the steady-state magnetising current was only of the order of a few milliamps, and it was the only relay which the author investigated that had a constant time delay and was entirely free from contact bounce. The power supply to the model transformers was obtained from a step-down transformer of sufficient rating to give a source impedance of less than 0·2 ohm.

Tests Applied

For specimens of both materials, a series of oscillograms were taken for various values of maximum flux density, switching at the worst angle, both with the core initially demagnetised and with maximum remanent flux. These were compared with the results given by several methods of calculation. A typical graph relating the peak current and the maximum flux density is shown in Fig. 4 which demonstrates that for a high resistance case the result of equation (8) is most applicable. It was noticed that, in several cases, better agreement would be given by taking a resistance of 80% of the actual resistance for use in this formula, although further results for other sizes of core would be necessary to establish this.

(To be concluded)

Measuring Earth Characteristics

AN INSTRUMENT FOR CHECKING RESISTANCE AND RESISTIVITY IN DIFFICULT AREAS

By H. R. MATHIAS,* B.Sc.(Eng).

IN the gravel soils of high specific resistivity in which most sites are chosen during construction work on the North of Scotland Hydro-Electric Board's schemes, standard earth-testing instruments are found to be inadequate. To meet this difficulty, the author evolved the instrument described in this article.

In earth resistivity measurements as shown in Fig. 1, two "potential" electrodes, usually steel rods, are used, and in earth resistance measuring, one such rod. It was found that the two rods could have a combined resistance of their own to earth, in series with the instrument, of up to 15,000 ohms, and for one rod to be up to 8,000 ohms.

The highest grade of instrument encountered in practice has ranges from 3 to 3,000 ohms. On the most used 0-30 ohms range of the available instrument, a correction factor of 150% on resistivity measurement and 75%on resistance measurement is possible due to this high electrode resistance, and it is not possible with the same instrument to measure the resistance of the electrodes when either of them exceeds 3,000 ohms as was usually the case. The extent of the error can thus be indeterminate.

On the more common types of earth tester, frequently in use by contractors, errors could be up to +500% and often were, e.g., for an actual earth resistance of 5 ohms the instrument might read 30 ohms.

D.C. Measurement

The circuit of the instrument used is shown in Fig. 2. The measuring is done by the aid of d.c. batteries only, this having the immediate disadvantage of requiring two readings instead of one. It is planned to incorporate eventually a small mechanical rectifier to convert to a square wave form the current passed through the ground, and simultaneously convert the voltage developed across the earth resistance due to this current back to d.c. to be measured.

The principle of the measurement of earth resistance is to pass a current through the resistance and measure the voltage across it. On commercial instruments this is done by having the voltage and current measurement coils on the same spindle, the pointer being scaled to read direct in ohms.

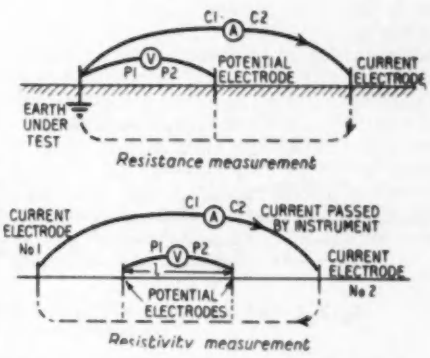


Fig. 1. Electrode connections for the measurement of resistance and resistivity

These remarks apply also to the measurement of earth resistivity which is in effect the measuring of the resistance of a known length of ground, the figure being multiplied by $2\pi l$ where l is the spacing of the potential electrodes in centimetres, to give resistivity in ohms/cm^3.

Electrolytic Effect

When two electrodes in contact with the earth are connected to a sensitive d.c. voltmeter, a voltage can be read due to the electrolytic effect of the soil's chemical constituents. When d.c. is used for resistance measurement this electrolytically derived voltage may increase or decrease the voltage being read due to earth resistance, depending on the direction in which the instrument is passing current. If a reading of voltage is taken, the direction of current flow and the polarity of the voltmeter then reversed, and a second reading taken, then the average of the two is the true voltage due to the earth resistance. It is possible for the electrolytic voltage to exceed that due to the earth resistance in which case only the

* *Mr. Mathias is with Kennedy and Donkin*

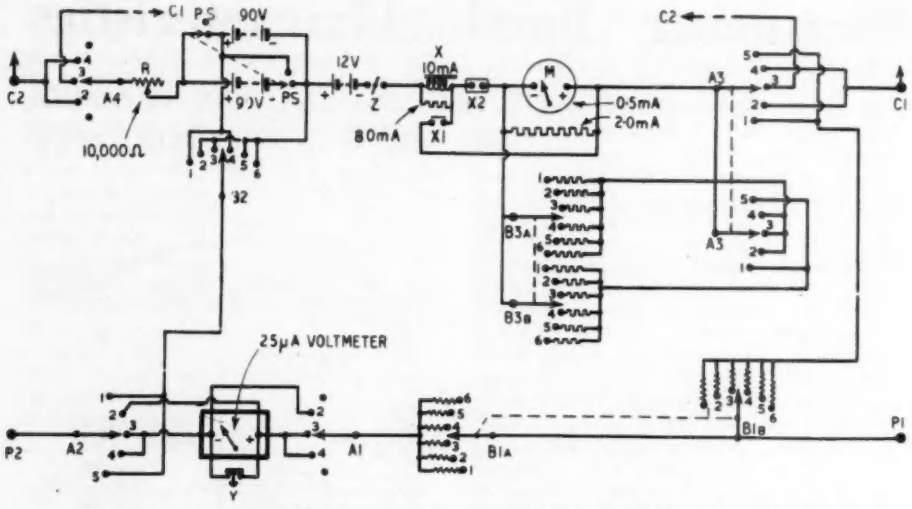


Fig. 2. Circuit diagram of earth testing instrument. A1-A4 and B1-B3 are the wafers of the control switches A and B respectively

direction of current flow is reversed, the second reading in such a case being taken as negative when the average of the two readings again gives the true earth voltage.

By adjusting the current passed each time to a set value it is possible to have the voltmeter scaled to read ohms direct and this has been done. On each of the three resistance ranges of 0—5, 0—25 and 0—250 ohms, the current is adjusted by the rheostat R to the mid-scale position of the milliammeter M. On each range a suitable shunt is selected for this milliammeter on B3A, the shunt being for 50 mA on all three, requiring a setting of 25mA (mid-scale) as the fixed earth current. A voltage of 102 is found sufficient, usually in conjunction with a 10,000 ohm variable resistance R, to provide this current but switch PS can switch the two miniature 90 V batteries from parallel to series connection, giving 192 volts if required.

On each resistance range a voltmeter series resistor is selected on B1A to give direct reading of ohms on the voltmeter with 25 mA of current.

Resistivity Readings

The resistivity ranges are 0—25,000, 0—500,000 and 0—2,500,000 ohms/cm cube, and on these reading is direct. Advantage is taken of the fact that the resistivity read is proportional to both the current passed and the spacing of the electrodes. By making the product I.l always the same the voltmeter can read resistivity direct. A second scale on the milliammeter reads in metres of spacing, a large spacing requiring in effect a low current and vice versa. The current passed is adjusted by R to the scale reading of the spacing chosen for the potential electrodes. A variation of from 2 to 30 metres can be used.

Selection of suitable shunts and voltmeter series resistors is made automatically with selection of range.

Control Positions

Switch A controls the direction in which current is passed and the polarity of the voltmeter, this being necessary as explained previously. Position 3 is normal, Position 2 reverses both the direction of current flow and the voltmeter polarity, Position 1 reverses the direction of current flow only. Positions 1 and 5 switch the voltmeter out of circuit, disconnect the current terminals C1 and C2 from the instrument and enable a current to flow through the milliammeter and the potential measuring electrodes. The magnitude of this current is determined by the resistance of the electrodes and the scale selected on Switch B. Selected at the same time as the scale are a shunt on B3B and a series resistance B1B for the milliammeter, together with a battery voltage on B2 of 12 or 102 volts. The milliammeter then reads direct on one of its two scales the percentage addition to be made, due to the resistance of the potential electrodes. This is achieved by so relating the selected correction measuring shunt and resistance to the overall voltmeter resistance

on each range that the percentage correction scale is suitable no matter what range has been selected. The accuracy of the method is not first grade as it depends on the nominal voltage of the battery being relied upon, but the degree of accuracy if the batteries are checked occasionally is high enough.

Voltmeter

The voltmeter used is essentially an 0—25 micro-ammeter, the resistance in series on the 5 ohm range being 5,000 ohms and on the 25 ohm range 25,000 ohms. A correction scale of up to 50% is found adequate with such a high resistance voltmeter. To safeguard the movement during transport and guard against accidental excess voltage it is clamped through a shorting switch Y. This has to be depressed while a reading is taken. A relay X which shorts out and disconnects the milliammeter from circuit on the passage of a current over 90 mA provides some safeguard for this meter. A switch Z in the battery circuit guards against accidental discharge when not in use.

Operation

The instrument is simpler to use than the description implies. Switch Z is closed, a range selected, the current adjusted to the correct point on the scale, Y depressed and a reading taken with switch A in its central position 3. Switch A is moved to position 2 or 4 whichever gives a forward movement of the voltmeter scale and a second reading taken. Switch A is then moved on into either position 1 or 5 depending on whether 2 or 4 was the last used, and a reading of the correction taken.

It has been found easy to use, accurate and versatile in its possible applications. It is not intended for use in heavily developed areas with many leakage currents flowing in the soil but has been found perfectly suitable in the remote, high resistivity areas for which it was built. The cost was under £10.

Our readers' views ...

Shop Lighting

IN Mr. Tate's article "Lighting the Shop Interior," published on March 19, in his criticism of the retail trade he seems to have overlooked the following points:

1. Since 1946 there have been very few watts available for lighting the goods.
2. To get the best use out of the few watts available, we have had to resort to naked lamps and, during one period, oil lamps and even candles. Everybody knows that bare lamp installations are not attractive.
3. The restrictions imposed by the B.E.A. have left very little scope for developing lighting schemes.
4. There has been a great deal of confusion of thought as to whether one should go wholly over to fluorescent or mixed, and the retail trade have been waiting to see what the illuminating engineers had to offer.
5. The standard designs available for fluorescent lighting are unattractive, restricted and costly. Possibly this may account for mounting fluorescents bare on the ceiling.

It is difficult to understand what is meant by the harm tungsten lamps do to the reputation of fluorescent lamps. The remaining information in the article is, of course, well known.

Oscar C. Waygood

LIVERPOOL, 1

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Rural Electrification

I FEEL that "Flitchman" in his letter to you published in your issue of March 12, has done less than justice to the Eastern Electricity Board. Subsequent to the publication of that letter positive action is being taken and plans are approved to provide this area with electricity in the near future, probably in the autumn of this year.

From our contacts with the electricity people who are arranging for the necessary wayleaves and the siting of the poles we have received the utmost courtesy and co-operation, and I have now gathered information that some of the delay may have been caused by the obstinacy of certain individuals in our own farming community.

"Anticipating"

STEBBING GREEN, ESSEX

NOTES ON WIRING by Megohm

The Electrical Section

SOME time ago I visited the Electrical Section at the Building Centre in London. My reactions to the general display and layout at that time was, to say the least, indifferent, and I found little to be enthusiastic about. In view of the fact at the time of my visit the Electrical Section had just been opened and maybe not fully complete, I felt as time went by improvements would be made, although I must confess I thought it a very poor answer when I requested information about a particular wiring system to be told the manufacturers had not supplied the Electrical Section with their catalogues and publicity matter in time for the opening. Soon after the opening an architect friend of mine told me he looked round in vain for an electric cooker and, believe it or not, he tells me he found one in the Hardware Section.

Descriptive Brochure

I have recently received the Electrical Development Association's brochure describing "The Electrical Section." This brochure has an attractive blue cover, but some of the text is so small that it is difficult to read. Fortunately, the opening pages are easily readable, and the statement made that electricity is synonymous with power and without an abundant, efficient electricity service our industries and the nation would stagnate, is one with which all electrical men will readily agree.

Omission and Commission

Reading on, I find there is described the very latest passenger-operated lift which has been installed in the Building Centre. No mention, however, is made of the modern escalator which is today gaining favour with large stores organisations for the rapid and safe movement of shopping crowds. Attention is also drawn to outsize model plugs and socket outlets and the display of under-floor ducts and industrial wiring systems. I cannot imagine the architect and builder is very interested in outsize plugs and sockets, and in general I would say they would prefer to see plugs and sockets made as small as possible.

Space is allotted to the layout of hot-water-pipe systems, incorrectly and correctly planned. Whilst there is emphasis on the severe restriction of space given to the Electrical Section in the Building Centre, one wonders why valuable space is wasted showing incorrect pipe layouts. Surely the architect and builder only want to know the correct pipe layout, and a display of one or more incorrect layouts can add to confusion in the minds of busy men.

Men of Vision

The main appeal in the brochure is to the architect and builder, and I like the directive that the architects and builders of today must be men of vision. I would add to this appeal, "so must men of the electrical industry." A permanent exhibition of clear conception and dramatic appeal to the general public and the building industry is one that has been wanted for many years. A collection of diagrams fixed to wall frames with descriptive matter is not likely to arouse enthusiasm, and the publication of an indifferent brochure is to be deplored. Surely the electrical industry is not so poverty-stricken that it cannot produce a really attractive and easily readable brochure. There is, no doubt, a good answer to the foregoing comments, and if it should be one of £ s. d., the sooner the electrical industry puts its house in order on this score the better.

Worthy Display

I hope in the not too distant future that the E.D.A. will be given the support it deserves to produce and maintain a really good Electrical Section, and I do plead that in future publications issued by them they should make sure they are printed so that they can be read without eye-strain and/or the use of a magnifying glass.

Maybe a lead was given at the Electrical Engineers' Exhibition, which opened last week at Earls Court. I understand there were displayed at this exhibition many interesting installation exhibits including an avenue of electric cookers and appliances and, in the main aisle, modern lighting equipment of every type using tungsten, hot and cold cathode lamps fitted in industrial and decorative fittings, the whole collection being connected to a modern overhead catenary wiring system.

STATIC ELECTRICITY

—Conference discusses its generation, dissipation, uses and harmful effects

LENGTHY correspondence a few months ago in the ELECTRICAL TIMES indicated the wide field in which static electricity had been experienced. Most of the personal experiences were confined to electricity generated on cars and other rubber-tyred vehicles, where little trouble had resulted from its generation, but in industry generally its presence can have far more serious effects. Last week, the Institute of Physics held a conference covering all aspects of this subject, indicating steps being taken to discover the means by which it is generated and methods to ensure its dissipation before it can do harm.

Generation by Rubbing

There are few readers who were not introduced to static electricity in the schoolroom when, with the aid of a gold leaf electroscope, its presence was discovered on an ebonite rod which had been rubbed on catskin. Returning to these fundamental methods, one of the first papers to be presented at the conference discussed the possibility that asymmetric rubbing was but one of two means by which static electricity could be generated. The other was by the contact, under pressure, of two surfaces of different materials, no rubbing being necessary. Most static electricity was due in practice, to a combination of both effects. Moreover, variations in the contribution of each method give rise to the notorious uncertainty of experiments designed to establish consistency.

Described in the paper as the "kinetic" and "equilibrium" theories, for asymmetric rubbing and contact methods respectively, recent experiments were conducted in an attempt to substantiate each theory and case, that of asymmetric rubbing, two sheets of polythene were rubbed together. Irregular patches of opposite charges were established on each surface, from which it is reasonable to conclude that in some cases of rubbing local asymmetrics are involved establishing opposite charges on the surface of the material, although each surface is neutral as a whole.

Turning to the "equilibrium" effect, a series of experiments were conducted, passing a "sandwich" of two different materials, in sheet form, through spring-loaded rollers, and measuring the charge on the inner sheet. A range of materials was chosen, including three metals, and every possible combination (except metal to metal) was tried. In almost every case a reproducible charge was established on the inner material and from the complete results a reasonably consistent electrostatic series could be built up, from which the author concluded there was sufficient evidence to suggest the existence of the "equilibrium" phenomenon.

Electrification of Fluids

That static electricity may be generated in fluids in motion has been established by incidents in the discharge of petrol from a hose and some indication of the cause of charges building up is given by a consideration of the Helmholtz double layer theory. Briefly this assumes that at any liquid-solid or liquid-gas interface polarisation takes place, in which a bound layer of charge appears on the surface equalised by a layer charge of opposite sign just within the liquid. Flow of the liquid tends to separate the charges, resulting in bulk charges building up at each end of the flow and, moreover, charge separation may take place at discontinuities in the inter-surface.

If, however, the liquid has a low resistivity, these charges are rapidly dissipated, but dangerous conditions may be established with liquids of low conductivity. The critical figure for resistivity is of the order of $10^9\ \Omega$ cm., any liquid having a specific resistance less than this figure being regarded as a good conductor.

Among conclusions to be drawn from these facts, is that if liquid of high conductivity is collected in an unearthed vessel it behaves as a charged conductor and can discharge by sparking to any earthed conductor brought near it. Stirring, often recommended in the past, will not hasten dissipation of the charge. It is more likely to separate further charges, resulting in sparking when the stirring rod is withdrawn.

Electrification in Freezing

Static electricity is also produced during the formation of ice in dilute solutions. A series of experiments on this phenomenon shows that the potential between ice and liquid increases

consistently, although not linearly as the ice forms until a limit is reached. No voltage appears until a critical value of dilution is reached, after which it increases to a maximum as the concentration falls, falling off when the concentration is reduced still further. The value of the potentials are also determined to some extent by the rate of formation of ice.

It is logical, in any consideration of the general principles of electrostatic generation, to include some reference to the dissipation of static charges. Much work on this latter subject has been conducted in the textile industry, where static electricity continues to be a source of trouble, as opposed to a danger, and results in loss of production time and deterioration of output quality. The main source of static electricity is the pressure of rollers on textiles, resulting in a net charge being carried away in the material.

Dissipating Charges

Methods of dissipating these charges fall into three categories: gaseous discharge from the surface of the material, conduction back through the material to its point of contact with the material, and discharge through surface conducting agents with which the material has been treated.

Under the first heading, experiments have shown that passing the cloth through a wire loop, or close to a conductor fixed above it, enables gaseous discharge to take place between cloth and conductor. In the first case, a virtually complete discharge may result. This does not seem, however, to be applicable to the problem of attraction and retention by the rollers of short fibres.

Dissipation by the second method is restricted due to lines of force from the material passing outwards from it when contact with the rollers is broken. The bulk conductance of the material plays an unimportant part until it reaches a critical value after which electrification falls away rapidly, due to direct conductance back to the roller before contact is finally broken.

Any non-electrifiable conducting agent present on the surface of fibres of the material serves to bridge the gap between fibre and roller in the contact area, simulating a parallel plate capacitor with a leaky dielectric. For such agents, a bulk conductivity of between 10^{-9} and 10^{-10} mho cm^{-1}, for a 3% oil application to the material, is sufficient to dissipate electrification, and other agents, of which "Lissapol N" is an example, may be used in smaller amounts, having higher conductivities.

Other methods for increasing the electrical conductivity of surfaces were discussed, these being in general applications outside the textile industry. Several types of surface films are available, already in use for purposes other than the dissipation of static electricity. Of these, some readers will be familiar with semi-conducting ceramic glazes used on insulator strings to distribute the voltage gradient uniformly over a series of insulators. This film has a surface resistivity of 0·2 to over 100 MΩ whereas that of stannic oxide, used as a conducting film on glass to prevent condensation, is anything from only 100 to over 1,000 ohms.

Metal Films

Pure metallic films may be obtained by spraying, but this brings with it difficulties of adhesion. Other methods are sputtering or evaporating the metal on to the surface under vacuum. A semi-conducting film may be made by heating lead silica glass in hydrogen, when particles of lead separate out. The resistivity of such films is approximately 1,000 MΩ.

Carbon can be a successful conducting medium for films as a colloidal suspension in liquids or finely divided in paints. These latter are unreliable as particles tend to become isolated. By a third method, carbon may be deposited direct on to porcelain. Mention may be made here of conducting rubber, obtained by a suspension of lamp black in the rubber. It may be possible that this can be applied in liquid forms to provide a conducting rubber surface.

Moisture Films

Moisture films form readily on certain surfaces, such as glazed porcelain, but it is obvious that such a film is unstable, due to its dependence on humidity and temperature conditions and the cleanliness of the surface. Moreover, care should be taken to ensure that heating effect of the current does not evaporate the film. On the other hand, formation of charges on "Perspex" and similar materials may be prevented by treatment with a surface wetting agent. Experiments have shown that "Lissapol N" reduces the discharge time of "Perspex" from several hours to a few seconds whilst with Teepol 530 agent the time is approximately one minute.

Static electrification constitutes a danger to life and property wherever explosive mixtures of non-conducting powders, or vapour and air are present, circumstances to be found over a wide field. Experiences mentioned in the

introductory survey serve to indicate the variety of situations. During the mid 1920's explosions in the dry-cleaning industry reached such alarming proportions that fundamental research was demanded into the subject.

Most of the explosions were associated with the "tumbler" type cleaning machine, in which clothing was contained in a basket held in a tub of cleaning fluid. On completion of the washing process, the liquid was removed, and the basket rotated rapidly to expel the liquid from the clothing. During this process a considerable charge was built up on the clothes, whilst letting in air created a highly explosive vapour, which was ignited by spark discharges to hands when the clothes were about to be lifted out. Great improvement came from the use of high flash point liquids, and low flash point liquids were consequently prohibited.

One of the disturbing factors of spark discharge is that a suitable resistance inserted in series with the discharge current increases the incendivity of the discharge. A pure capacitance discharge in a cloud of starch has a critical energy value of 100 joules below which the cloud will not ignite, yet introducing a resistor of correct resistance in series with the capacitor reduces to 0·2 joules the stored energy required to ignite the cloud. It seemed to the speaker that problems of static electrification were more difficult of solution today than 20 to 25 years ago. Although attempts have been made on an individual basis he felt there was a need for a centralising influence to co-ordinate, correlate and condense this work. If the conference did no more than bring out this need, he felt it would not have failed, but it may be the seed from which such an organisation should grow.

For a practical estimation of hazards of static electrification, some indication should be made of the controlling condition. Charges are brought about initially by a separation of positive and negative charges, these transferred to a container or dissipated. Their maintenance depended on the resistivity of the material of the container, and materials having a value of less than 10^9 Ω cm can be regarded as conductors, whilst a resistivity of over 19^{11} Ω cm is necessary for change maintenance.

PAPERS AT THE CONFERENCE ON STATIC ELECTRIFICATION

Author	Title of Paper	Firm or Establishment
PROFESSOR F. A. VICK	"Contact Electrification—A Survey" (Lecture)	University College North Staffs
	"General principles of the Generation and Dissipation of Static Electricity"	
P. S. H. HENRY	Introductory Survey	British Cotton Industry Research Assoc.
W. FORDHAM COOPER	"Role of Asymmetric Rubbing in Static Generation"	H.M. Inspector of Factories
	"Electrification of Fluids in Motion"	
E. W. B. GILL	"Electrification by Freezing"	Oxford University
W. R. HARPER	"Liquids giving no Electrification by Bubbling"	Imp. Coll., London
J. S. FORREST	"Methods of Increasing the Electrical Conductivity of Surfaces"	B.E.A. Research Labs.
J. A. MEDLEY	"Dissipation of Electrical Charges Generated by Rollers"	Wool Industries Research Assoc.
	"Electrostatic Machines"	
E. S. SHIRE	Survey	Cavendish Lab., Cambridge University
PROF. N. FELICI	"Ten years of Electrostatic Research at University of Grenoble"	Grenoble University
	"Useful Applications of Static Electricity"	
R. TILNEY	"Electrostatic Coating Processes"	Henry W. Peabody (Industrial), Ltd.
D. H. LUCAS, H. J. LOWE	"A Survey of Electrostatic Precipitation"	B.E.A. Research Labs.
A. S. CROSS	"An Electrostatic Field Meter"	Kodak, Ltd.
	"Harmful Static Electrification"	
H. W. SWANN	Introductory Survey	Min. Lab. and Nat. Service
W. FORDHAM COOPER	"Practical Estimations of Electrostatic Hazards"	H.M. Inspector of Factories
D. BULGIN	"Static on Rubber-tyred Vehicles" "Factors in the Design of an Operating Theatre Free from Static Risks"	Dunlop Rubber Co., Ltd.
J. A. MEDLEY	"Electrostatic Charging of Some Polymers by Mercury"	Wool Industries Research Assoc.
P. S. H. HENRY	"Static Eliminators in the Textile Industry"	British Cotton Industry Research Assoc.
A. QUINTON	"Safety Measures in Operating Theatres to Minimise Explosive Risk. Use of a Radio-active thallium source to dissipate static electricity"	Queen Elizabeth Hospital, Birmingham
A. G. PEACE	"Electrostatic Ignitibility and Electrification of Finely Powdered Hexamine"	North Staffs Technical College
G. MORRIS	"Ignition of Explosives by Condenser Discharge—Effect of added circuit resistance"	I.C.I., Ltd.

Humidity was naturally an important factor, causing wide variation in both bulk and surface resistivity. Control of bulk resistivity and humidification, where possible, are the best methods for suppressing charging.

Experiments involving the measurement of electrostatic voltages and fields must avoid disturbing the existing conditions as far as possible. For that reason voltmeters should have a high internal resistance and good insulation, whilst with field measurements it is necessary to make the air in the vicinity of the search electrode conducting to avoid disturbing the field. Usually the provision of a radioactive tip on the probe is sufficient for this purpose.

As the static spark energy required to ignite gas vapours is small and for dust clouds only a little greater, risk of explosions under these circumstances is rarely absent. Although electrostatic charges are rarely large, a spark is a danger where such mixtures are present, and the best means of preventing explosions is by keeping the vapour or dust concentration outside the critical limits.

Specific cases of hazards include the rubber-tyred vehicle which may be regarded as an excellent generator. Potentials of up to 50 kV on cars are not uncommon, with a possible maximum of 110 kV. Whilst modern cars tend to generate a voltage 30% higher than pre-war models due to greater mudguard clearances. Moreover, road surfaces can be charged to quite high potentials, 30 kV having been measured.

Apart from the possibility of electric shock to vehicle users, which might result in accidents due to muscle reaction, static electricity brought about the phenomenon of "ozone" puncture. This, a slow puncture effect, is due to ionisation of the air on the inner wall of the outer cover and punctured the inner tube. The use of "anti-static" tyres made from conducting rubber—already fitted to most passenger vehicles, was sufficient to dissipate charges and remove these effects.

Regulations on Fireguards

FIREGUARDS will be required to be fitted to almost all electric and gas fires or oil heater sold on or after October 1, 1953. This is the effect of the Heating Appliances (Fireguards) Regulations 1953, which were published on Monday. The exceptions are, first, that any heating appliance completed before that date and not having a suitable guard, may be sold or let under a hire purchase agreement up to October 1, 1954. Secondly, where an appliance is let under a hire purchase agreement or on simple hire, the date of sale or hire for the purpose of the regulations is deemed to be that on which the appliance first came into the possession of the hirer.

Where fires are imported into Great Britain after October 1, 1953, the exemption about date of manufacture does not apply.

For the purpose of the parent Act, regulations lay down a schedule of tests for checking that any fireguard complies with the required standards of construction and fitting. In general these tests are those laid down in BS.1945: 1953, and specific reference is made to that standard. The tests involve the use of a conical test probe to check the mesh and spacing of the guard, and they require that dry flannelette placed over the guard does not smoulder or ignite within ten seconds of being put into position, with the fire full on. In addition there are requirements as to the strength of the guard under mechanical pressure tending to distort it.

A saving clause in the regulations permits the sale of heating appliances without a guard to bona fide scrap merchants. It is further stated that the regulations apply to heating appliances of types designed so as to be suitable for use in a dwelling house or other residential premises.

The Heating Appliances (Fireguards) Act lays the duty of securing compliance with the regulators upon local authorities. They may authorise their offices to inspect and test appliances required to be fitted with guards and in England and Wales may institute proceedings for any offence under the Act committed in their area.

Offences

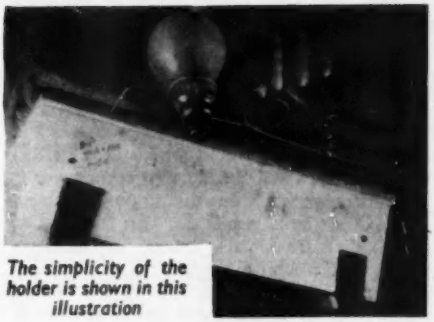
Offences under the Act are punishable on summary conviction by a fine not exceeding £50. Where the offence has been committed by a corporate body with the consent of directors, managers, etc., these individuals are liable as well as the company.

The number of the Statutory Instrument is 1953, No. 526. In addition a similar document, The Heating Appliances (Fireguards) (Scotland) Regulations, 1954, has been published as S.I. No. 524, to meet the legal requirements of that country.

PROBLEMS AND PRACTICE in Engineering

Stepladder Holder for Lamps

WHEN changing bulbs or cleaning fittings which require a ladder in order to reach them, the big problem is to know where to place the bulbs so that they will be safe and not suffer accidental damage. I have seen some men climb down the ladder in order to lay the bulb on a bench top and then climb up again in order to complete his job on the overhead fitting. He repeats the journeys up and down once more in order to replace the bulb.



The simplicity of the holder is shown in this illustration

It is much more efficient, less fatiguing and reduces accidental breakages if a simple wire rack for holding bulbs is fitted to the top plank of a pair of steps. The rack is made from a single length of stiff iron wire in which is formed three loops of a size sufficient to hold the largest bulb likely to be encountered. The ends of the wire are bent over at right angles and are pushed into a pair of holes drilled in the edge of the top plank of the steps. If the correct size holes are drilled to suit the wire diameter, the bulb holder can be pushed into place and no further holding means are required. The rack can be removed easily when not required any more.

The rack is very useful when doing the periodic rounds of the lighting fittings for bulb replacing and shade cleaning, and enables the work to be done by climbing the steps once for each light instead of making a number of journeys.—*C. T. Bower.*

Fused Test Prods

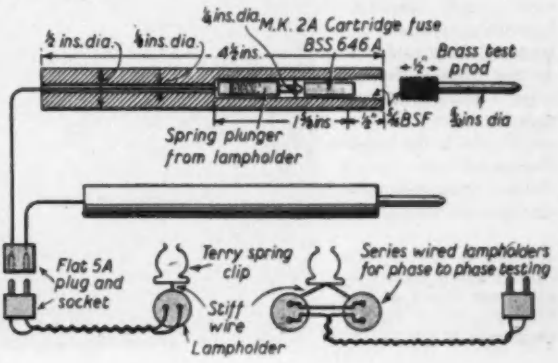
THE drawing gives details of a pair of fused test prods which I made up for use with lamp assemblies for testing by normal test methods. The handles are made from fibre insulating rod of ½ in. dia. the lengths of which are 4½ in.

First a hole ⅛ in. dia. was drilled right through the rod, then at one end a hole ¼ in. was drilled down to a depth equal to the lengths of the lampholder plunger plus the length of the threaded portion of the test prod less ⅛ in. Next the rod was drilled and tapped ⅛ in. B.S.F. to a depth of ½ in. This allows the prod to be screwed in pressing the cartridge fuse on the spring plunger.

The drilling was done on a lathe for accuracy and the prods were made from ⅛ in. brass rod threaded ⅛ in. B.S.F., then turned down to $\frac{5}{32}$ in. The spring plungers were taken from a lampholder and are of the two-section type with flex entering the top, the flex screw needs to be cut off flush and reslotted to allow the plunger to slip inside the tube.

For convenience of testing either single-phase supplies or phase to phase testing two lamp assemblies were made up either of which can be easily connected to the prods by means of flat 5A plug and socket fittings as shown. To avoid the test lamp dangling about, I fixed the lampholders with stiff wire to spring clips which can be clipped to one of the prod handles when in use: P.V.C. tube was fitted over the brass prods to within ½ in. of the top.—*I. Pacey.*

Detailed drawing of the fused prod and the method of fixing lampholders



The KITIMAT-KEMANO Hydro-Electric Scheme

Further details of the Great Power Project in British Columbia

WE have had occasion before—particularly in our issue of April 17, 1952—to refer to the gigantic hydro-electric scheme in British Columbia now being carried out by the Aluminium Co. of Canada. It may be remembered that this huge project was made possible by the unusual geological formation at the coast, where the eastern watershed runs closely to the seaboard, being separated by a range of mountains which slope steeply down to the coastal valleys. This made practicable the utilisation of a large catchment area by the drilling of a tunnel to use the eastern watershed to supply a power station located underground near one of the west coast rivers.

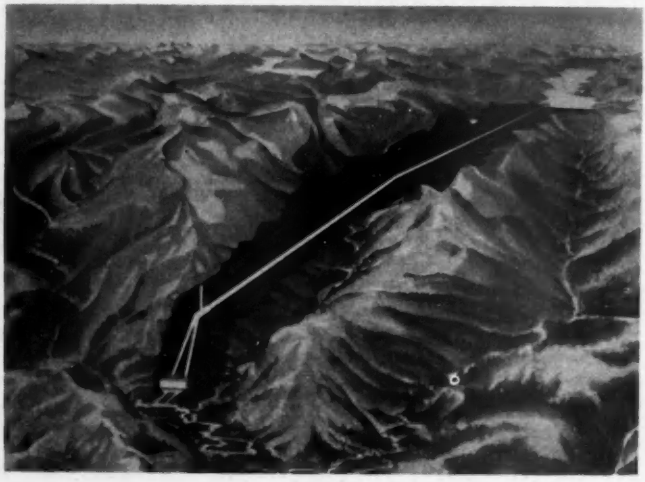
Precipitation over the watershed ranges from 100 in./annum on the high westerly portion to 20 in. on the low easterly sections. The area of catchment above the Kenney Dam, which will create a storage reservoir of 873×10^9 cu ft, is 5,475 sq miles, to which an extra run-off from 290 sq miles can be artificially added. This will provide a firm flow of about 6,920 cusecs under a net head of 2,500 ft to give an estimated output of 1,718,000 h.p.

Water System

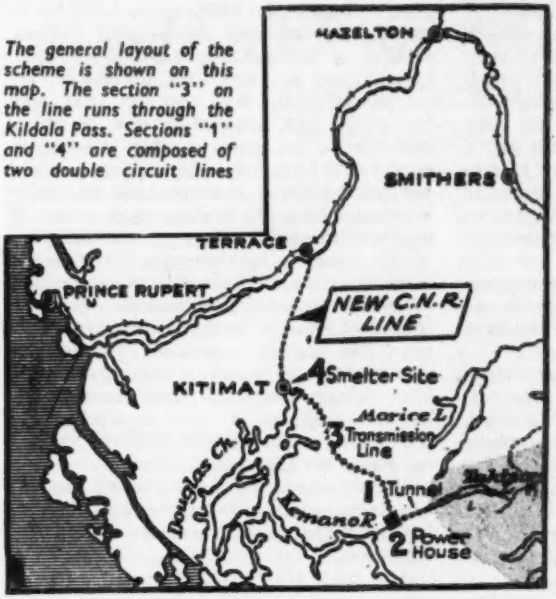
Further details of this remarkable scheme were made available last Friday by Mr. F. L. Lawton, Chief Engineer of the Power Department of Aluminium Laboratories, Ltd., in a paper read at the Royal Society of Arts.

The principal construction in the storage system is the Kenney Dam, a structure of the rockfill type built out of the excellent local materials with a very large factor of safety. The dam is located across the Nechako River, and has a length of 1,550 ft, with a crest width of 40 ft and a maximum height of 317 ft. The full reservoir level is at a height of 2,800 ft datum. Slopes of upstream and downstream faces are 1 in 2·5 and 1 in 1·75, and it is estimated by competent authorities that the structure when completed will require no maintenance and should have a life measured in geological rather than historical time. Overflow of surplus or flood water is carried out at a location remote from this important structure. Other large works are also involved to impound and control waters in auxiliary storage and catchment areas.

As can be seen from the artist's sketch, water will be taken from the west end of Tahtsa Lake to the power station by tunnel. There will actually be two unlined tunnels, each about 10·1 miles long, from the intake to the surge chambers. (The sketch shows only



This artist's impression shows one tunnel running from the lake to the underground power station



The general layout of the scheme is shown on this map. The section "3" on the line runs through the Kildala Pass. Sections "1" and "4" are composed of two double circuit lines

one.) These tunnels will be of 25 ft diameter and will be spaced 300 ft apart. Normally each tunnel will carry 3,500 cusecs, but they can carry 4,500 maximum.

Pressure System

From the surge chambers, pressure conduits lead down to the power station and they and the power station are located a considerable distance within the mountain mass. Several reasons for this exist, but principal considerations include the saving of steel which otherwise would be needed for external conduits, saving in maintenance, less vulnerability to air attack, saving in concrete, and convenience of working due to the rigour of external climatic conditions.

The pressure system for the first half of the station (using No. 1 tunnel) consists of the surge chamber, a steel Y branching into two 11 ft diameter conduits each about 4,000 ft long and each serving four generating units, and a manifold to give the four 5 ft diameter branch pipes, and the necessary butterfly valves. The pressure conduits will be steel-lined, the thickness ranging from $\frac{3}{8}$ in. at the upper end to $1\frac{11}{16}$ in. upstream from the manifold. The turbine feed pipes will be $2\frac{1}{2}$ in. thick. The rock has been tested to 3,600 lb/sq in. and found perfectly satisfactory for withstanding the water pressures expected.

Access to the power-house will be through a tunnel with a length of 1,400 ft, the actual excavation for the station itself in the solid rock being 1,135 ft long, 81 ft wide, and 134 ft high. When completed it will contain 16 vertical, single-runner, four-nozzle impulse turbines each rated at 140-150 thousand h.p. and connected to 106 MVA generators (60° C. rise). The sets will run at 327 r.p.m.

A double-primary bank of three single-phase 71-89 MVA transformers will step up the output of each pair of generators to 300 kV from the tail-end voltage of 13·8 kV, and 300 kV oil-filled cables, 2,150 to 2,260 ft long, and about 4 in. o.d. will take the power to the outside switch-house. The nozzle centre line in the turbines is at 210 ft datum to give a gross head of 2,585 ft with a net head of 2,500 ft. Water is expelled into the Kemano River through two tailrace tunnels, one of 1,050 ft and the other 1,100 ft long, each dealing with eight units.

Transmission

The aluminium reduction plant, located at Kitimat, is fed from the power station by overhead line at 300 kV. This line for the first ten miles comprises two double circuit tower lines, climbing to 1,000 ft datum, where they feed into a switching station. The outgoing lines from this station consist of two single-circuit lines running to an altitude of 5,300 ft in a distance of 10·6 miles, where a further switching station is located. Finally, two further double-circuit lines run the remaining distance at an average altitude of 2,500 ft to Kitimat. The 10·6 mile stretch runs through the narrow Kildala Pass, where clearances are not sufficient for two double-circuit towers. Over this section the conductors will be ACSR (S.C.A.) with an outside diameter of 2·295 in. and an ultimate strength of 135,700 lb. Triple or quadruple strings of 18 insulator units will be used for suspension, and sextuple strings of 20 for strain applications where found necessary.

Because of the heavy loading, a network analyser was used to investigate the system characteristics, and large condenser banks are to be installed to maintain a p.f of 0·92.

At the aluminium-reduction plant the

terminal station will be somewhat similar in arrangement to that at the generating station, except that there will be ultimately 12 step-down transformer banks, normally each supplying a single potroom with bussing facilities to permit transfer of power to other loads, a bank for miscellaneous load and a spare bank. It is visualised there may be synchronous condensers, but most of the corrective capacity will be in the form of static capacitors on the low-tension side of the step-down banks.

For communication between Kemano generating station and the Kitimat aluminium-reduction works, power-line carrier facilities will be installed.

The step-down transformer banks are single-phase OFW type transformers rated at 37,000 kVA, with a voltage ratio of 275/13·2 kV, with four 2·5% taps, the neutral being solidly grounded.

Each cell line or potline will be supplied by eight mercury-arc rectifier equipments, of the ignitron type in the initial establishment, each rated at 12,500 kW. These equipments comprise a single-tank, 1,200 amps, 1,000 MVA interrupting capacity, outdoor oil circuit-breaker, a self-cooled phase-shifting transformer rated at 13,200 kVA (of which two provide 15° phase shift, four 7·5° shift, and two at 0°) and arranged to give 48 phase operation, a self-cooled rectifier transformer rated 13,200 kVA, with a three-phase primary and two six-circuit wye-connected secondary windings. These 12 windings supply the 24 anodes of two rectifier frames, each consisting of 12 pumped, ignitron-type, water-cooled rectifiers with auxiliaries. The cathodes of the 16 frames are connected through high-speed air circuit-breakers to the positive main d.c. bus. The neutral points of all secondary windings are connected to the negative d.c. bus, through interphase transformers. The rectifier equipment will have an efficiency of somewhat over 96 per cent, from the 13·2 kV a.c. bus to the 1,000 volt d.c. bus.

The step-down transformer banks are protected on primary and secondary sides by induction-type phase and neutral overcurrent relays.

Experience with Spreader Stokers

BRITISH experience with spreader stokers of the "Rotograte" type was outlined in a paper by T. H. Lindsey and P. Pilkington (Babcock and Wilcox), presented to the Institute of Fuel last Tuesday, at the Institution of Mechanical Engineers. The spreader stoker concerned was originally developed in America in order to facilitate the burning of low grade fuels, and the first order in this country was placed in 1945 for Kearsley Power Station. Trials were also carried out on a pilot plant at the Renfrew Works of Babcock and Wilcox.

Experience at Kearsley

At Kearsley early troubles were experienced with feeders and the moving grate, and although most of these were overcome, grate-bar breakages persisted for several months. The causes of these were ultimately traced to inadequate clearances, and, after these had been corrected, breakages fell to small proportions. Several modifications were also made to the secondary air arrangements and the positioning of overfire air nozzles to reduce slagging effects on the boiler tubes.

The Staythorpe installation also suffered from grate-bar breakage, but in this case it was found to be due to slag falls from the rear walls. These were eliminated by the provision of extra soot-blowers. Severe wastage of the Bailey blocks and of the lower part of the back wall was also found. The side wall trouble proved to be due to the perfection of the side stoker seals. This was eliminated by making provision for additional air to come in at the sides.

The worst rear-wall trouble was largely eliminated in the course of dealing with heavy bonded deposits which developed in conjunction with severe metal attack on the secondary and primary superheaters. This was attributed to the amount of chlorine in the coal combined with a reducing atmosphere in the superheater zone. Considerable alterations were made in the secondary-air arrangements and the trouble largely eliminated, although one of the coals used has had to be abandoned due to the high chlorine content which still resulted in heavy deposits. This fuel had chlorine values of 0·55 to 0·6%. The efficacy of spreader stoking could be gained from the fact that boiler efficiencies up to 90·91% had been attained, and a great advantage is the rapidity with which the boiler firing could be altered to deal with fuels of widely differing constitution.

In their conclusions the authors expressed confidence that industry will show an increasing interest in spreader firing in the future.

SAFETY in INDUSTRY

CHIEF INSPECTOR OF FACTORIES REPORTS ON EXPERIENCE DURING 1951

ELECTRICAL accidents in factories during 1951 totalled 715, of which 34 were fatal. These figures are given in the Report for that year of the Chief Inspector of Factories, which was published last week. The total is the lowest to be recorded since 1938, although in all years since 1945 the level has been between seven and eight hundred. Accidents in Great Britain from all causes during the year totalled 182,616, of which 828 were fatal.

Portable Apparatus

A detailed analysis of the electrical accidents in relation to apparatus is given in Table 1. The report notes particularly that if the eye-flash cases are excluded, 34·5% of all accidents involve portable apparatus, and it is concluded that much greater attention will have to be given to this type of equipment if there is to be any appreciable reduction in the overall total of electrical accidents.

Earthing shortcomings are another subject for special comment. The earthing system was involved in 79 electrical accidents, and of these, thirteen incidents were fatal.

Once again the report draws attention to the dangers associated with building operations carried out near overhead transmission lines. Since 1939, there have been 25 fatal and 39 other accidents caused by persons making direct or indirect contact with such lines. In 17 fatal and 26 non-fatal instances machines such as travelling cranes or excavators have touched the overhead lines. Apart from emphasising the danger, however, the Report does not make any recommendations for new safety procedures. It notes that the use of height gauges on either side of a line where it crosses a roadway has been suggested, but observes that this may not always be a favourable proposition, an instance being where machines are being used to level a site.

Cranes inside factories also give rise to anxiety, particularly from the aspect of contact with trolley wires. After describing some accidents that have occurred in this respect the report notes approvingly the present-day trend towards enclosing the wires completely or else dispensing with them. Alternatives to trolley wires include spring-loaded reeling drums, together with suitable t.r.s. cables; the use of pre-kinked festooned t.r.s. cables suspended in "pig-tails" from bobbins threaded on a simple catenary wire; a double cable-drum arrangement which eliminates the need for winding springs; and a contact skid system used in conjunction with fixed supply points.

Limit switches attract comment in respect of a tendency to replace the robust equipment of the past with small micro-switches. There appears to be some misgiving about this, and it is emphasised that the miniature switches are designed for a.c. circuits only, and that the greatest care is needed in applying them to d.c. circuits.

Welding

With the use of electric welding still increasing, the report makes reference to the associated danger of shock accidents. It notes that on the Continent several fatal accidents have occurred on a.c. systems operating at 100 volts and below.

Experience has shown that danger of shock in positions of intimate earth contact is reduced to a minimum by the use of direct current. In the past the difficulty here has been the necessity to use rotary machines, which involve expensive maintenance and a high initial cost. Now the position is improving, in that metal rectifiers are being used to produce the direct current with chokes in the alternating current circuit, so that the energy losses are much less than with conventional d.c. welding methods. Moreover,

TABLE 1. ACCIDENTS/100,000 MAN-HOURS: REPRESENTATIVE FIGURES.

Industry	Estimated Employees			Number of Factories			Frequency Rate		
	1949	1950	1951	1949	1950	1951	1949	1950	1951
Engineering, light electrical and radio ...	50,800	55,500	81,900	43	47	56	0·88	0·80	0·82
Engineering, general and heavy electrical ...	106,700	120,800	134,800	74	73	95	1·32	1·27	1·18
Electricity generation (B.E.A. Divisions) ...	10,900	32,000	33,100	11	15	14	2·79	2·57	2·38
Engineering, light, including instruments ...	59,400	54,600	79,500	102	87	101	1·33	1·14	1·03
Engineering, general and heavy	452,400	440,400	432,000	398	414	419	2·20	2·07	1·72

the advantage is offered that the electrical load is distributed across the three phases of the supply.

Titanium-coated rods can greatly assist voltage reduction, the arc voltage varying between 48 and 25 volts, depending on the current. Other promising developments include a 2-phase welder with a Scott-connected transformer and a twin electrode holder, which uses a welding voltage usually below 30 volts, and the argon arc process using spark injection, with a welding voltage of about 40 volts. Where a.c. sets of conventional pattern are in use, it is suggested that the open-circuit voltage reducing relay, which is widely used on the Continent and in America, deserves better support in this country.

REPORTABLE ELECTRICAL ACCIDENTS IN RELATION TO APPARATUS, 1951

Apparatus	Fatal		Non-Fatal		Total
	Men	Women	Men	Women	
Portable apparatus—					
Portable electric machines ...	7	—	32	5	44
Portable heaters and irons ...	—	—	7	4	11
Portable lamps	5	—	15	—	20
Portable test sets incl. lamps ...	1	—	30	—	31
Plugs and adaptors	2	—	26	2	30
Cables and flex, for portables ...	2	—	38	1	41
Electric hand welding:—					
(*a*) Shock and/or burns ...	—	—	17	—	17
(*b*) Eye injuries	—	—	152		152
Fixed apparatus—					
Electrical machinery	—	—	8	—	8
Transformers	1	—	3	—	4
Switchgear above 650 volts ...	4	—	41	—	45
Switchgear below 650 volts ...	1	—	87	5	93
Fusegear	—	—	48	—	48
Crane trolleys	1	—	26	—	27
Fixed lamps	—	—	14	3	17
Cables for fixed apparatus ...	6	—	69	1	76
Test leads	—	—	6	3	9
Apparatus not classified ...	4	—	37	1	42
Total	34	—	504	25	715
			Plus 152 eye-flash accidents (welding)		

Industrial Developments

In the general summary which precedes the more specialised sections of the report, it is noted that an increasing number of managements are recognising that production depends on a sound and reliable electrical installation coupled with effective maintenance and careful planning.

The general standard of electrical equipment in factories is noted as having been satisfactory. Aluminium-sheathed v.r.i. cable was widely used in new factory installations during the year, and the report notes that experience and tests have shown that commercially pure aluminium is more durable than other materials in many situations, and that electrical continuity and low overall resistance can be maintained.

In connection with the operation of higher-voltage (700 V) electro-chemical processes mentioned in earlier reports, it is considered that a year's experience shows that there is a considerable shock risk, and that care and close supervision of operating personnel are necessary to prevent serious accidents. Contact rectifiers may provide an alternative, and it is noted that new 10,000 amp 260-volt converters are being installed in chemical works here, while in France a plant to supply 40,000 amps at under 200V is being installed.

During 1951, special visits were paid by the Inspectorate to representative factories using X-rays for work of various kinds. The voltages employed ranged from 2 MV where boiler shells had to be examined, down to 50 kV for X-ray crystallographic sets. Apart from minor points of criticism, the report records that a very high standard of equipment, installation and use was found.

There was a growing use of radio-isotopes during the year, in particular Cobalt 60, Iridium 192, and Tantalum 182, and the question of protection in handling the large sources involved began to cause some concern. Discussions were held with manufacturers of suitable protective carrying equipment, and there is hope of progress in this connection. Apart from such questions of handling strong sources, there were no other major points of difficulty encountered in the safe handling, use and storage of radio-isotopes.

Lighting

Steady progress during 1951 in the artificial lighting of factories is noted, attributable in the main to the widespread use of fluorescent tubes. Over the last ten years a remarkable improvement in standards of lighting has taken place, particularly in small and medium-sized factories. Many common defects previously noticed in such premises have been eliminated by the use of fluorescent lamps.

Considerable attention has been paid to schemes for combining artificial and natural lighting. In some workshops the level of natural lighting has been found to vary between 250 and 1 lumens/sq ft over a distance of 25 feet. In such situations, artificial lighting is necessary during daylight hours.

ANALOGUE ANALYSERS

Recent Developments in the Transformer-Type of Computor Described at I.E.E. Supply Section Meeting

IN our issue of March 2, 1950, we published an article dealing with the operating principles and the construction of the "Blackburn" network analyser, developed prior to the war by Mr. C. L. Blackburn and installed in Carliol House, Newcastle on Tyne. The increasing requirements for machines to solve problems introduced by the ever-growing complexity of modern transmission and distribution systems, have caused this type of analyser to come under closer investigation, and its possibilities and potentialities to be explored in more detail.

Operating Principle

The latest work on this machine, was described last week at the I.E.E. in a Supply Section paper presented by Mr. M. W. Humphrey Davis, and Dr. G. R. Slemon (Imperial College). They began by giving some details of the fundamental operation of the analyser. (In this connection a reference to the ELECTRICAL TIMES article mentioned above may be useful.) Fundamentally it depends on the fact that in a perfect voltage transformer, the ratio between input and output voltages is determined solely by the turns ratio, or $V_1 = \frac{n_1}{n_2} V_2$ This equation is made analogous to $V = RI$, or by a simple but ingenious extension, to the in-phase or quadrature voltages $V_p = RI_p - XI_q$ and $V_q = XI_p + RI_q$. This process is carried out by the introduction of additional windings wound additively or subtractively as required. It is also possible to connect units to represent

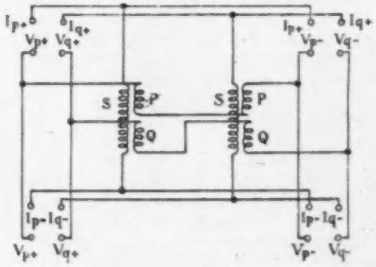


Fig. 1. Basic circuit of a complex impedance

transformers, and by changing connections of the terminals to make them represent admittance units when they may be used as current sources. As can be seen from the diagram in Fig. 1, connections are fairly straightforward, being by four-pin plugs, and as all the quantities are in terms of voltage, contact difficulties are minimised. The transformer windings are tapped, and in the units described the windings S are fixed at 1,000 turns each and P and Q are tapped in steps of one turn to give ratios from 0·001 to 0·999. The pair of P windings and Q windings are ganged together and their ratios

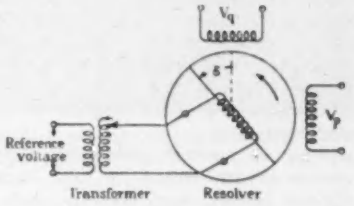


Fig 2. Method of deriving various values of quadrature and in-phase voltages by a special source unit

fixed by two sets of three tapping switches.

In order to simplify certain studies, a source unit capable of giving in-phase and quadrature components with a directly available angular difference has been developed and is shown in Fig. 2.

When connecting the units, the coils with voltages proportional to current components are connected between the top and bottom sets of terminals while those with voltages proportional to voltage components are connected from side to side. A simple series-parallel circuit is shown set up in Fig. 3. In certain circuits, where crossover occurs, the normal method of connection would result in a short circuit in some of the unit coils, and in these circumstances an additional coil is used on the transformers to avoid the physical connection.

The paper continued by giving extensions of the basic principle to cover such requirements as transformer representation, mutual impedance and the solution of sets of simultaneous equations.

Approaching the Ideal

Although the fundamental principles of operation are fairly easy to comprehend, they are all based on the concept of an ideal transformer. Such a transformer cannot of course, be manufactured as it would need to have zero leakage flux and zero magnetising current. However, the leakage flux can be reduced to small proportions by correct design (and work is still proceeding to determine the best core shape and arrangement), and the magnetising current can be supplied by an external source using an electronic circuit. A compensator unit has been developed which can give almost complete compensation of the fundamental component of magnetising current.

Measurement

As all the variables in any problem are represented by in-phase and quadrature components which in turn are represented by voltages in the analogue, electronic volt meters may be used to measure their values without throwing an undue burden on the system. Phase shifting and adding may also be carried out electronically, and by the use of amplifiers a dynamometer instrument may be used to record all readings.

The paper concluded by giving some typical applications of the analyser to load studies, short-circuit studies, and stability, and to the solution of linear equations such as are used in the derivation of performance

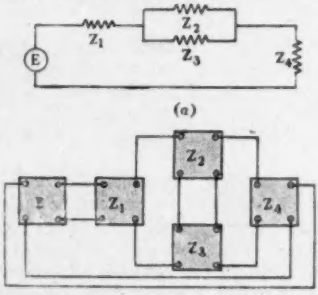


Fig. 3. Method of setting up the units to represent the circuit shown

characteristics of induction machines, commutator machines and control systems. The system adopted of presenting fundamental data was based on Kron's work "Equivalent Circuits of Electric Machinery" and involved matrix notation.

As far as precision was concerned, the limiting factor was the accuracy of the voltage transformers. This, however, was sufficiently good for most network problems, although in the solution of simultaneous equations higher accuracies would probably be needed.

DISCUSSION

MR. C. L. BLACKBURN (Merz and McLellan), said that the Newcastle machine with 48 panels was possibly rather on the small side. For many problems one would like to be able to go up to 70 or 80 panels. It was possible to get away with a smaller number of panels with the transformer-analogue analyser than with one of the conventional types. The principle of the transformer-analogue network analyser was applicable to some very interesting physical problems.

MR. L. GOSLAND (Electrical Research Association) said that a drawback to the extended use of the Blackburn type analyser was that there had been no satisfactory evaluation of the overall accuracy to be expected. However, given the courage to build larger equipment incorporating the kind of compensation which was now available the errors would possibly be within the order which was to be expected in engineering problems.

MR. K. W. WARDROP (British Electricity Authority) showed some comparisons between the transformer-analogue analyser and the direct type, with particular reference to the study of power-system problems. His personal opinion was that as a general computing machine, not only for power-system problems but for all kinds of problems outside, the transformer-analogue analyser was ideal.

MR. W. J. GIBBS (British Thomson-Houston Co. Ltd.), said that as an electrical machine designer he liked the analogue because it dealt primarily with a complex number of equations and not with circuits.

MR. G. LYON (Merz and McLellan) said it was rather difficult to make comparisons between types of analyser because the same amount of development effort had not so far been put into the perfection of the Blackburn type. At the present time it appeared that the Blackburn type could give equal facility at less cost.

MR. T. M. WHITELEGG (A.E.I. Research Association), said that he had attempted to increase the speed of operation on the direct type of analyser and in his view the development of the automatic load-adjuster, was as quick as the transformer-analogue analyser for performing load studies.

MR. J. G. MILES described how the problem of determining the starting torque of a synchronous motor was solved with both types of analyser, and for which the actual test results were available. He showed that the analogue had been far more accurate in its predictions.

MR. D. O'KELLY showed some slides illustrating a number of solutions which had been obtained with the transformer-analogue analyser at the Imperial College.

MR. R. A. HORE (Merz and McLellan) discussed the problem of applying analogue analysers to mechanical problems.

Orders and Output—1952

BRUSH ELECTRICAL ENGINEERING CO.

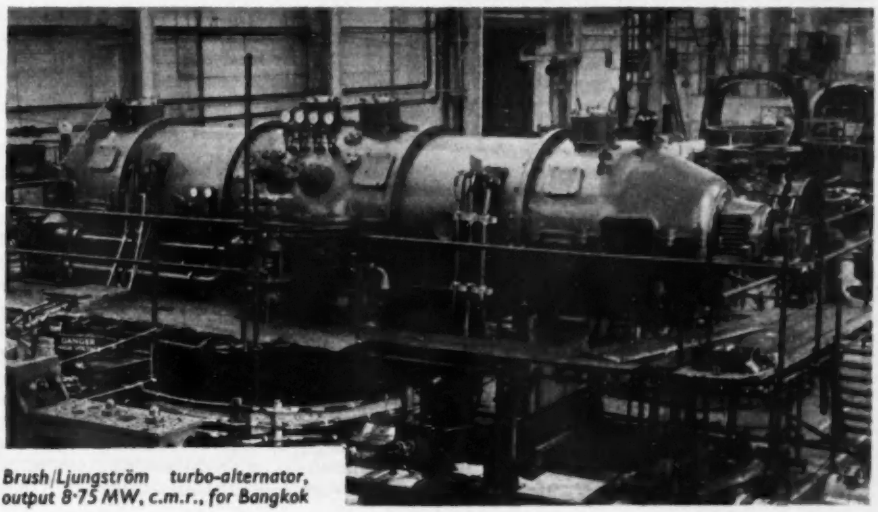
FAVOURABLE progress throughout last year is reported in all this company's divisions, particularly in the turbine division where last year saw the successful completion of the Ljungström modernisation programme. During the last five years, 22 machines mostly owned by the B.E.A. and ranging between 15 and 50 MW in size have been re-bladed, and the company states that their subsequent operation fully justified the decision to proceed with modernisation.

Completed Sets

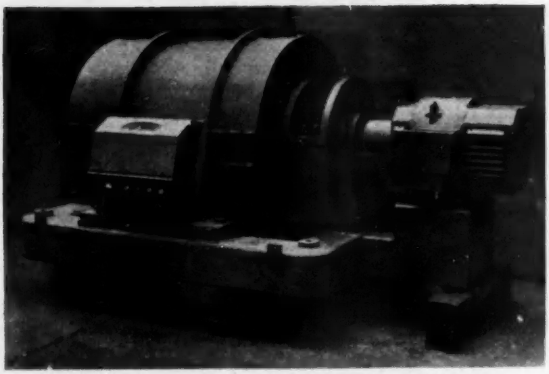
Among other orders completed in 1952, was that for a 30 MW set for the Authority's Warrington Station, whilst in the export field, two 6.25 MW sets, to be installed at Lourenço Marques in Portuguese East Africa, were completed for the Portuguese Government. Another set, 2·4 MW rating, also completed last year, is destined for the Kano power station of the Electricity Corporation of Nigeria. In addition, a number of smaller axial-flow turbines were supplied last year to sugar industries in Australia and Africa, and to cement mills in India.

Two 3,750 outdoor type transformers for Denmark, 60,000/10,800V, 50c/s, provided with on-load tap-changing equipment

An order for three 15 MW Brush/Ljungström sets for Queensland is among those in



Brush/Ljungström turbo-alternator, output 8·75 MW, c.m.r., for Bangkok



A 1,175 b.h.p. synchronous induction motor 1,500 r.p.m., 3,300V, 50 c/s, 3-phase for Uganda

hand. Others include two 8.25 MW sets for Bangkok and eight machines, totalling 175 MW for the B.E.A. with a repeat order for a 12.5 MW Brush/Ljungström set to be installed alongside a previous set early this year.

Transformers

The bulk of work on high voltage transformers is taken up by export orders, including 132 kV units for Australia and others at voltages from 110 to 66 kV for South Africa and Tasmania. In the home market, however, several 66 kV units were built. This work was accompanied by extensions to factory facilities confined to the drying-out and processing departments. Continued work related to standards has formed an important part of the year's activities.

As reported in our issue of August 7, the company opened their new h.v. test laboratory in which a number of official impulse tests have since been carried out, whilst elsewhere developments had continued in the fields of noise measurement, short-circuit forces, and the application of grain oriented steel.

Overseas Orders

From the Pretoria Municipality was received an order for four 20 MVA 33/11.5 kV transformers complete with on-load tap-changing equipment following up an identical order delivered during 1952. Other overseas orders included one for 71 transformers, aggregating 206 MVA, and ranging in size from 1,000 to 15,000 kVA, from the Electricity Supply Commission, Rand Undertaking, South Africa. In the dollar market, the largest order received from the Hydro Electric Power Commission of Ontario was for ten 3 MVA transformers.

Switchgear

In the Switchgear division continued expansion was recorded during the year, further space being allocated for switchgear construction and development purposes. Work in the latter category included the development of the P.H.K. 35 closing mechanism in which the company's associates, Bryce Berger Equipment, played a contributory part. Also developed during the year were circuit-breakers of 350 MVA capacity, for 11 and 6.6 kV. These are now being incorporated in vertical lift switchgear which is becoming available. That section of the division devoted to the production of fused switchgear was also kept busy on equipment for industrial application in both home and overseas markets.

Orders for outdoor circuit-breakers were received last year from Area Electricity Boards and from an Indian electricity supply undertaking, these being of 750 MVA capacity for 33 kV. Switchgear of the indoor pattern, up to 250 MVA at 15 kV was supplied to the N.C.B. and also a large steel works and oil producing and refining companies. Overseas markets, including the United States of America and Canada were similarly supplied with switchgear of this type.

Rotating Machinery

Considerable reorganisation of testing facilities in this division took place during the last year, and two new test areas were laid out. One will be for the largest engine-driven alternators, the other to serve d.c. machines, including generators for traction purposes.

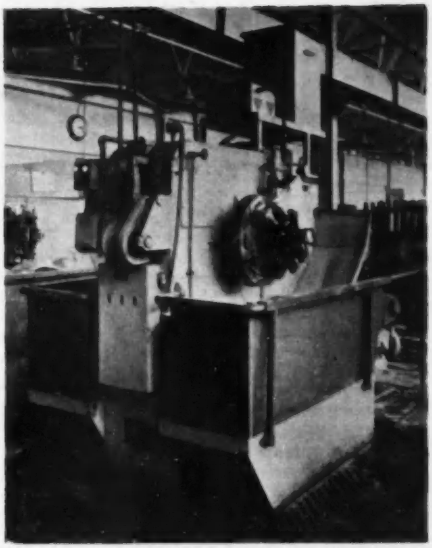
Much of the work in both induction and d.c. motor shops has been devoted to defence orders, but an increase in production space enabled the Company to accept further orders for mining and industrial type flameproof motors and d.c. machines. Among these was an order for fifteen 60 V, 2,000 A motor-driven electrolytic plating sets. These sets are for an entirely new application. Orders for alternators were received for machines of all types. The range actually covered extended from 50 to 2,000 kVA. As a result of considerable research and development work undertaken by this division during the year, 1953 will see the production of both an increased range and new types of rotating machines.

Electronic Control of Glass Grinding

AN interesting example of electronic control as applied to the edge-grinding of glass sheets has recently been installed by the General Electric Company at the St. Helens works of Triplex (Northern) Ltd. The sheets are mounted in pairs on a rotating chuck and a grindstone, rotating at constant speed, is kept in contact with the edge of the sheets by counterweights. The speed, however, at which the glass passes over the stone is critical and the chuck speed must be accurately controlled to ensure that the glass is ground to the correct profile.

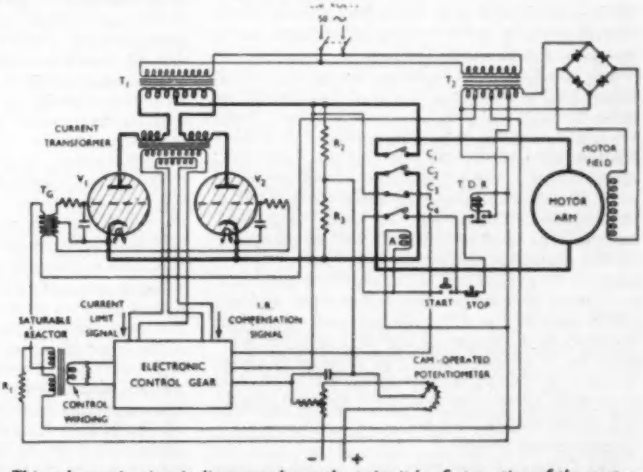
To carry out this variation, an electronic equipment has been devised which controls the speed of the 1 h.p. driving motor by means of a reference voltage produced by a cam-operated potentiometer. As can be seen from the schematic diagram, the motor field is excited from a metal rectifier fed from the secondary of transformer T_2, the armature supply being derived from the thyratrons V_1 and V_2. Control of the armature current and therefore of the motor speed is effected by comparing a fixed proportion of the thyratrons' output voltage, with the reference voltage derived from the cam-operated potentiometer. The resulting difference voltage is fed to an electronic amplifier, the output of which controls the operation of a phase-shifting network in the grid circuits of the thyratrons so as to increase or reduce the speed of the motor as required.

To start the machine, the main switch is first closed to connect the transformers T_1 and T_2 to supply. The motor field is immediately energised from T_2, which also supplies the heating current of the thyratrons and power pack of the amplifier. The time delay relay T.D.R. is energised and gives sufficient time for the thyratrons to warm up before closing. The motor is then started through push-button (start) and contactors C_1, C_2, C_4; C_3 controls the operation of the electronic gear so as to give a gradually increasing load on the thyratrons.



View of machine with electronic control equipment mounted above

Two auxiliary control circuits are also provided, energised from a current transformer in the anode circuit of the thyratrons. One limits the armature current to a safe predetermined value to avoid overloading of the thyratron, while the other compensates for the natural drop in speed of the motor with increasing mechanical load.



This schematic circuit diagram shows the principle of operation of the system

overseas news

Quesnel River Scheme

The British Columbia Power Commission is preparing plans to build the first of four dams on the north forks of Quesnel River to produce a 42,000 h.p. power project at a cost of about $9,000,000. The four dams are to be built between Cariboo Falls and the north fork of the river, and are part of a plan to supply up to 89,000 h.p. Money to finance the project will come from the additional borrowing powers, details of which we noted on March 19. The question of utilising the Quesnel River for power generation has been under discussion for several years. The cost of the north fork development is admittedly expensive, and officials of the Power Commission have been reluctant to recommend it for that reason in the past. The Commission seriously studied the south fork of the Quesnel where costs would be much lower and with at least twice as much power available. But the International Fisheries Commission, which has spent much money in re-establishing the salmon run on the south fork, violently opposed damming in that area, and apparently have won the day.

Bearspaw H.-E. Scheme

Contracts have now been placed by Calgary Power, Ltd., for the civil construction work at Bearspaw Dam for the hydro-electric plant. Total cost of the dam is estimated at $5½ millions. Site of the plant is about 14 miles west of Calgary on the Bow River. The dam will be 1,300 ft long and 56 ft high, and the associated turbines will develop 22,000 h.p. The main section of the dam will be about 225 ft of concrete blocking the river, with three sluice gates for flood discharge.

Project for Newfoundland

The Newfoundland Light and Power Co. is now engaged in a search for material with which to build a dam for a new power project on the Piper's Hole River. The total potential of Piper's Hole River is more than 70,000 h.p., and it is hoped to develop the full power over a period of years. Plans of the Company call for a three-stage development. There will be three generating stations, one supplied by the 195-foot dam, one further upstream, and one at Tidewater. The first stage of the project will be the dam and generator to produce 30,000 h.p. This will be either a single 30,000 unit, or two of 15,000 h.p. each. It will be followed by a smaller station at Tidewater, supplied by a 40-foot head, and developing about 12,000 h.p. The up-stream station will be the last to be built, some years from now, and will supply, it is estimated, 20,000 h.p.

Centralised Control

The Calgary Power Co., Ltd., largest supplier of electricity for Alberta, has decided to install a centralised automatic control system whereby the company's nine southern Alberta dams and power plants will be controlled by a one man push-button system. Completion of the scheme is expected by 1954.

N.W. Ontario Development

First details of the largest power construction programme ever undertaken by the Hydro-Electric Power Commission of Ontario in north west Ontario, have been disclosed by Mr. R. H. Saunders, chairman of the Commission. That part of the Province is on the eve of tremendous development, and power resources must be greatly expanded by 1956, he stated. Additional units are to be added to the new Pine Portage development. One large new plant will be built on the English river, between Kenora and Red Lake; and survey parties will spend the summer getting detailed information at Manitou Falls and Boundary Falls. (The latter is almost within a stone's throw of the Manitoba border.) It has not yet been decided which of these two sites to utilise, but Boundary Falls is the larger, with a potential 160,000 h.p., or four times as much as Manitou Falls. The principal reason for this development is believed to be the large scale expansion at the Steep Rock iron field, where output is to be boosted about seven times by 1960—equal to almost twice as much as the Canadian steel industry's annual requirements.

Lighting Change by C.G.E.

The Canadian General Electric has decided to dispose of its fluorescent lighting fitting plant to J. A. Wilson Lighting and Display Co., of Toronto. This move of C.G.E. follows the practice of General Electric in the U.S. in this respect. But the Canadian company will continue to supply basic components. C.G E. began manufacture of fluorescent fixtures in 1944, but finds a number of manufacturers have since entered the field. It feels the demand is best met by selling these manufacturers components and acting as a distributor. In addition, an expanding electronics business has placed heavy demands on space at its Royce Avenue works in Toronto where it makes fluorescent fixtures.

A Copper Find?

Three mining men returning from a helicopter expedition into the mountains of northern British Columbia say they and a rival group have staked claims on a "fabulously rich" copper deposit, it is reported. They have staked 72 claims on an ice-covered 7,000 ft peak known as Leduc Glacier. The reported copper strike is in the rugged Alaska-British Columbia borderland territory about 137 miles north of Prince Rupert. The deposit is described as being a zone of 4,000 ft long and 100 ft wide, running through the hill to

an unknown depth. Assays are claimed to have shown the deposit to run 25% copper per 100 ft. Traces of gold and lead were also found.

Beauharnois Award

The decision of the Arbitration Board on the expropriation of the Beauharnois Light, Heat and Power Co. has at last been announced. The former shareholders have been awarded $15,502,909, or approximately $20 per share, to which is added interest at 5% since 1944, making a total of $30 a share. The shareholders had claimed $80 per share. The Beauharnois undertaking was expropriated by Quebec in 1944. Ever since, there has been a controversy over the amount to be paid to minority shareholders of the company. Control of the Beauharnois stock was acquired by Quebec Hydro-Electric Commission in 1947 through acquisition of the shares of Montreal Light, Heat and Power Co. Originally, the Commission made an offer for the shares which would have left nothing for the common shareholders. The offer was refused. The three-man arbitration board subsequently turned down a motion by the shareholders that the value should be based on the earning power of the company.

Threat to R.E.A.?

The question of a possible threat to the operation of the National Rural Electric Co-operative Administration in America, to which we referred on March 12, is again raised by the news that Mr. Claude Wickard, head of the Administration, has been forced to resign by the Republicans, although his ten-year term of office had two years yet to run. It is suggested that this is to make room for someone more in sympathy with General Eisenhowers' adminstrations' aim of reducing the part played by the Federal Government in the generation and distribution of electricity. Meanwhile there is considerable interest in the hearings, which are to take place this month, on the application of the Idaho Power Co. to build three dams on the Snake River. Private companies are apparently hoping for an indication of more favourable treatment.

Underground for Rio

The question of building an underground railway in Rio de Janeiro, Brazil, is again in the news. It is now reported that a contract for the preparation of the final project has been agreed between the Prefecture of the Federal District and the French company, Societe Generale de Traction at d'Exploitations.

Undertaking Acquired

The seizure of the Beirut Electricity Co. by the Lebanese Government a few days ago, has brought strong protests from the French Government. The company's undertaking was taken over on the ground that it had failed to carry out the obligation under its concession to supply sufficient power for domestic and industrial purposes in Beirut. The company, on the other hand, claims that the tariffs as fixed by the Government are so low that it is suffering loss, and under such conditions it is not prepared to apply for a loan for development purposes. Through their ambassador, the French Government has stated that if the Lebanese Government maintains its seizure of the company France might be forced to reconsider the 1948 Franco-Lebanese financial agreement under which she guarantees the Lebanese currency. They also claim that the agreement protected the company against such seizure.

Calcutta Railways Electrification

The Indian Railways Board is to carry out a survey in regard to the possible electrification of the Calcutta suburban lines. The Railway authorities have asked for a grant of Rs. 2 lakhs to cover the cost of the survey, including a report on all aspects of the proposal, including its economics. The Railway Board, apparently, has come to the conclusion that a stage has been reached in the development of Calcutta's suburban railways when steam traction can no longer cope with the traffic. Electrification alone can increase the capacity of the lines, it is adjudged. The survey is likely to take about six months.

Tasmania's Wisdom

Power output of Tasmania will be increased by 70,000 h.p. by the middle of the year from the Tungatinah plant, Mr. Cosgrove, the Premier, stated recently. He was answering criticism for diverting the bulk of loan money to pushing on with hydro-electric development plans. He pointed out that in Victoria the State Government had spread its loan funds over a large number of projects. As a result, millions of pounds worth of equipment was rapidly deteriorating because the funds were nearly exhausted. The decision of the Tasmanian Government to proceed with the hydro-electric development plan would mean that the Commission would be in a position to earn more money for the capital invested and industry would be able to absorb more labour. Mr. Cosgrove added that, under a Bill now before Parliament, control of irrigation schemes would be vested in an irrigation branch of the Hydro-Electric Commission, which is to be established.

Progress at Tully Falls

Workmen have completed the first major tunnel job in the Tully Falls hydro-electric project. The 700-yard tunnel which is 11 ft in diameter, has been finished in 14 months. The next task for Queensland Contractors Pty. Ltd., who are doing this work, is the 1,100-yard tunnel to the power house site at the base of the mountain.

PERSONALITIES

IN THE INDUSTRY

The end of last month brought the retirement of **Mr. W. C. Bowler,** M.I.E.E., district manager of the Severn Vale district of the Midlands Electricity Board. His successor in that position is **Mr. F. Freeling,** A.M.I.E.E. Prior to nationalisation, Mr. Bowler was for over 20 years electrical engineer and manager for the Warmley Rural District Council, having carried out the whole of the electricity scheme from its inception for that Council. Under his progressive guidance, very low tariffs were introduced and the undertaking claimed that 97% of the potential consumers were connected to the mains. Mr. Bowler was also responsible for the design and carrying out of the electricity undertakings at Budleigh Salterton, Bridport and West Bay while he was with the late Mr. T. Hood, consulting engineer, of Bristol. Since nationalisation, operating from Chipping Sodbury, he has continued the work of extensions, and some 100 miles of h.t. mains have been commissioned. We understand that he has retired to Bath where he is taking an interest in two local concerns. Mr. Bowler's successor, Mr. F. Freeling, has served in the Commercial and Engineering Departments at the Central Gloucestershire subarea of the Board. Prior to nationalisation he was with the West Gloucestershire Power Co. He was recently elected hon. secretary of the Western Centre of the I.E.E.

Mr. W. C. Bowler

Deputy station superintendent at Ironbridge generating station since 1948, **Mr. T. E. Stanley** has been promoted to station superintendent there in succession to **Mr. P. M. Pinder,** M.I.E.E., M.I.Mech.E., who has retired. Mr. Stanley commenced his career as an articled apprentice to the Walsall Corporation Electricity Supply Department, where he subsequently rose to the position of relief charge engineer. In 1937 he was appointed to a similar post at Ironbridge power station where he later became charge engineer before going to Ocker Hill power station in 1942 as assistant station superintendent. During the re-planning which occurred at that station, Mr. Stanley also carried out the additional duties of assistant mechanical clerk of works.

Mr. B. H. Mears, director of Associated British Oil Engines (Export) Ltd., and National Oil Engines (Export) Ltd., has been appointed sales director of Mirrlees, Bickerton and Day, Ltd.

Mr. H. G. Martin, A.M.I.E.E., has been selected as deputy superintendent at the Hackney generating station, and will take up his duties in the near future. After service with the Dartford Borough Council, Mr. Martin was at Brimsdown from 1940 to 1949 leaving to go as shift charge engineer at Littlebrook, where he has been to date.

District commercial engineer at Tynemouth district in the Tyne sub-area of the North Eastern Electricity Board, **Mr. R. J. Oliver** is shortly to retire on having reached the age limit. Mr. Oliver has served in the area for a considerable time.

Mr. F. R. Moberly, A.C.A., has resigned his directorship of the Richardsons, Westgarth and Co., and has also relinquished the appointment of secretary. He is succeeded as secretary by **Mr. J. M. Ireland,** C.A.

Mr. H. Fothergill, Mr. T. B. Hall, Mr. J. Liddell, Mr. J. E. Smith, Mr. B. B. Wyatt, have been appointed to the board of Richardsons, Westgarth (Hartlepool) Ltd.

The first general manager and deputy chairman of the Central Electricity Board of the Federation of Malaya, **Mr. F. P. Egerton,** C.B.E., M.I.E.E., retired at the end of last month. Mr. Egerton arrived in Malaya in September, 1926, and was appointed assistant electrical engineer, Seremban, Negri Sembilan, in the former Government Department of Electricity. He was appointed director of electricity, Government of Malaya on April 1, 1946, after the liberation of Malaya. For his services in the transfer of the Government Electricity Department to the Central Electricity Board, he was awarded the C.B.E. in the recent New Year Honours List.

Mr. F. P. Egerton

Malaya, in fact, owes much to Mr. Egerton, for he has been responsible and has achieved more for the promotion of the production and supply of electricity in Malaya, than any other person. The crowning success of his achievement lies in the commencement of commercial operation of Connaught Bridge power station, near Kuala Lumpur, (which we described last week), officially opened by His Excellency the High Commissioner of the Federation of Malaya last Thursday. Mr. Egerton is now leaving Malaya for a well earned retirement in the United Kingdom.

Acting on medical advice, **Mr. Walter Tonkinson,** director and chief engineer of the Electric Construction Co., retired at the end of March. He joined the company in October, 1898 and became a member of the Test Department staff in May, 1901, transferring to the Machine Design Department in June, 1907 and becoming chief engineer of the company in May, 1915. He was appointed a director in April, 1942. During his 54 years with the company Mr. Tonkinson has been responsible for many important electrical power applications, both at home and overseas. He has resigned his directorship as well as his appointment as chief engineer.

Mr. Walter Tonkinson

Two new appointments are announced by the Plessey Co., Ltd. Appointed a member of the executive board of the company is **Mr. A. Blount,** who for the last seven years has been general manager of Vandervell Products, Ltd. **Mr. R. I. Hughes,** A.C.I.S., who has resigned his position as managing director of the Ford Motor Co. of India to join Plessey's administrative establishment.

Mr. R. I. Hughes

Mr. A. Blount

Three prominent members of the staff of the London Electricity Board retired at the end of March. They are **Mr. Robert Lee,** M.B.E., M.I.E.E., A.M.I.Mech.E., sub-area liaison officer, **Mr. H. C. Wells,** M.I.E.E., engineering adviser to the Board's chief engineer, and **Mr. J. W. J. Townley,** C.B.E., M.I.E.E., manager of the North Eastern sub-area. Last week they were presented with Long Service Awards by **Mr. H. J. Randall,** chairman of the Board. The Board has made the following transfers effective from April 1. **Mr. G. J. Moody,** M.I.E.E., previously manager of the Northern Sub-area, transfers to the North Eastern sub-area in a similar capacity; **Mr. L. H. Welch,** B.SC., M.I.E.E., formerly manager of the Western sub-area, goes to a similar position with the Northern sub-area, and **Mr. C. W. Blake,** who has been manager of the South Western sub-area, takes over a similar post in the Western sub-area. Mr. Lee's association with the Supply Industry dates back to 1903. He started as an apprentice with the Darwen Corporation undertaking, but went to Stockport in 1905 where he ultimately became borough electrical engineer in 1929 after a short period in a similar position at St. Helens (Lancs.). In November, 1931, he was appointed borough electrical engineer to St. Pancras Borough Council, a position he held till 1948, when he became sub-area liaison officer. Mr. Wells was connected with the County of London group of undertakings from 1908. He became chief mains engineer of the County Co. in 1933 and in 1939 his duties were further extended to cover the group of subsidiary undertakings operated by the company. When in 1945 a scheme of reorganisation was put into effect whereby the work was decentralised, Mr. Wells then became technical adviser (transmission and distribution) to the rearranged group of undertakings. He was appointed deputy chief engineer to the London Board in 1948, and engineering adviser to the chief engineer in 1949. Mr. Townley is another of those very popular members of the industry. He is probably best known for his 18 years' work as borough electrical engineer and manager at West Ham prior to vesting day. There, he was responsible for many innovations which brought rapid electrical development, and he was also primarily responsible for the construction of the new Canning Town power station until 1948. He was awarded the C.B.E. for his work in improvising supplies during the air raids, in which West Ham suffered severely. Born in Scotland, Mr. Townley gained experience with electricity undertakings at Paisley, Manchester, Ashton, Sunderland, Barnsley and Bradford (as deputy city electrical engineer) prior to serving as chief electrical engineer to the L.C.C. Tramways from 1927 to 1929, when he went to West Ham. Their numerous friends in the industry will join with us in wishing Messrs. Lee, Wells and Townley long and happy retirements. They have truly earned them.

Mr. H. C. Wells

Mr. Robert Lee

Mr. J. W. J. Townley

D

Mr. Frank Foster, M.Sc., A.M.I.E.E., has been appointed general manager of Crompton Parkinson's "Cyc-Arc" Stud Welding Division. After graduating at Leeds University, he joined F. and A. Parkinson, Ltd., and served for a number of years on the sales engineering staff. Following a varied experience in light and heavy electrical engineering both in this country and the Far East, Mr. Foster joined the General Sales Department of Crompton Parkinson, Ltd., in 1937. He was closely associated with the expansion of the company's interest in the field of fractional h.p. motors until he entered their Overseas Division in 1948 to manage the export of plant products.

Mr. F. Foster

W. T. Henley's Telegraph Works Co., Ltd., announce that as from April 1, 1953, **Sir John Dalton** has joined their board, and was appointed chairman of the company in succession to **Sir Montague Hughman.** It is stated that Sir Montague is remaining on the Board. It will be recalled that the preliminary announcement of this change in chairmanship was made in November last, and followed Sir Montague's decision to retire, which he announced at the annual general meeting of the company in May, 1952. On Monday last, Sir John was presented with a silver cigarette box from the staff of C.M.A. as a token of their esteem.

Just elected president of the Electric Light Fittings Association for the ensuing year is **Mr. Cecil A. Hughes,** A.M.I.E.E., F.I.E.S., director and sales manager of Siemens Electric Lamps and Supplies, Ltd. He succeeds **Mr. K. Scott Adie.** Mr. Hughes joined Siemens in 1910, and became manager of the Lamp Department in 1924 and sales manager in 1940. He was chairman of E.L.M.A. in 1949/50 and 1950/51.

Mr. C. A. Hughes

The Minister of Fuel and Power has made a number of reappointments of part-time members of the Electricity Boards. These are as follows:—

South Eastern: **Alderman E. Simms, Rt. Hon. Viscount Falmouth,** Comp.I.E.E., M.I.Mech.E.; **Mr. C. G. Morley New,** M.I.E.E., and **Mr. W. J. Oswald,** A.M.I.E.E.

Southern: **Rt. Hon. A. Creech Jones** and **Lt. Col. D. S. Kennedy,** D.S.O., J.P., M.I.Mech.E., M.I.B.Ag.E.

South Western: **Mr. A. N. Irens,** M.I.E.E., A.F.R.Ae.S., and **Mr. H. M. Medland,** J.P.

East Midlands: **Alderman A. Joyce,** C.B.E., J.P.; **Alderman J. Minto,** J.P., and **Alderman A. Sturgess,** O.B.E., J.P.

South Wales: **Mr. L. Parsons.**

North Eastern: **Mr. C. I. C. Bosanquet,** M.A., D.C.L.; **Col. E. G. Angus,** C.B.E., M.C., T.D., D.L., and **Alderman C. F. Anderson,** J.P.

North Western: **Mr. J. R. Potts,** O.B.E., J.P., and **Mr. E. J. Smith.**

OBITUARY

Mr. F. P. Best, M.Sc., B.Eng., A.M.I.E.E., technical manager of the Marconi International Marine Communication Co. Ltd. and the Marconi Sounding Device Co. Ltd., died on March 27. He had been associated with the former company since 1928, following amalgamation with the Radio Communication Co., with which he started in 1924. He was a well-known figure at international conferences on radio matters.

Mr. J. A. Begley, B.Sc., A.M.I.E.E., of the Belfast Corporation Electricity Department, was accidentally electrocuted on March 16.

British Standards

Vitreous-enamelled steel reflectors for use with mercury electric discharge lamps. *B.S.* 1950: 1953. *Price* 2*s. net.* Based on requirements given in B.S. 232 (which refers to similar reflectors for tungsten filament lamps), this new standard applies to reflectors used for mercury discharge lamps, types MA/V and MB/V. Four sizes of reflector, commonly known as the open dispersive type, are covered, their light distribution classified in B.S. 398 as class A (III)—direct intermediate. Clauses on material, dimensions, test lamp, luminous output and other factors associated with reflectors are included.

Thermosetting synthetic-resin bonded-paper round tubes for use at radio frequencies. *B.S.* 1951:1953. *Price* 2*s.* 6*d. net.* A new addition to the series dealing with synthetic-resin bonded-paper materials for electrical insulation purposes, this standard specifies requirements for two grades of round tubes for use at radio frequencies, and is thus complementary to B.S. 1314 and B.S. 1885. Electrical and physical properties for tubes up to 1 in. outside diameter are specified, together with appendices covering test methods.

Patients' trolleys (fixed top) for indoor use in hospitals. *B.S.* 1962:1953. *Price* 2*s.* 6*d. net.* In the preparation of this new British Standard, careful consideration has necessarily been given minimising risk from static electricity. To this end, trolleys are required to be fitted with castor tyres of an anti-static rubber composition, tested in accordance with a standard as yet unpublished. Details of these tests are however given in an appendix, which states upper and lower limits for the resistance of these tyres.

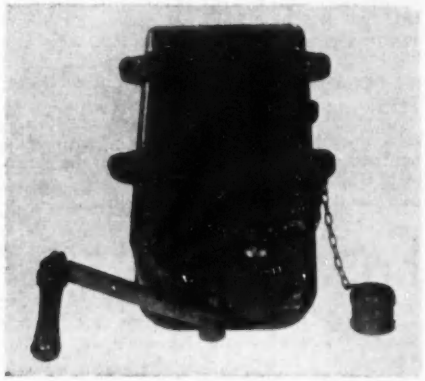
The BUYER'S *Column*

Venner's Lifeboat Transmitter

THE incidence of a number of tragic sea disasters in recent days has brought more into prominence the helplessness of those survivors who have no means of attracting rescuing ships and aircraft or of giving their position.

With this in mind VENNER ELECTRONICS, LTD., Kingston By Pass, New Malden, Surrey, have produced the Venner S.O.S. Life-Saving Transmitter which, simple and almost foolproof in design and inexpensive in construction, provides a means of directing attention to the boat by radio signals up to a range of 20–30 miles.

The transmitter is a small box which is intended to be screwed under the thwarts of all ships' boats and other small vessels. This contains a hand



Fitted under a boat's thwart this unit sends out a continuous emergency call

generator unit which in turn powers a transmitter comprising a crystal-controlled oscillating valve followed by a power amplifier. The shaft end of the generator is extended to form the drive of the signal code disc which is in turn geared down to provide a signal keying sequence. The code disc is formed by a series of cams so that it will send out a continuous alarm interspersed with S.O.S. or other alarm signals.

This continuous keying which will continue as long as one of the survivors has the strength to turn the handle at the required minimum speed makes it easy for searching vessels and stations to pick up the signal and by direction-finding equipment track down the boat.

The 8 ft extending rod which is attached to the transmitter makes it possible to send out a continuous signal with a range of up to 30 miles on the 2 mc/s R/T. emergency watch frequency.

Multicore Tape Solder

INTENDED for the jointing of flexible cables and small components without the need for the use of a soldering iron, the Multicore tape solder which is introduced in 1s. packs by MULTICORE SOLDERS, LTD., Maylands Avenue, Hemel Hempstead, is melted with the heat from an ordinary safety match.

This solder is sold in the form of a $\frac{1}{8}$ in. wide tape on an attractive printed card with complete instructions for its use.

This novel form of solder contains cores of Ersin extra active non-corrosive flux and thus no extra flux is required. The firm stress that it is not a substitute but is of the same quality as the well-known Ersin Multicore solder.

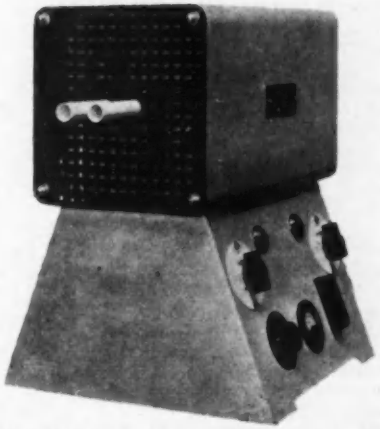
For jointing lengths of flexible cable all that is required is for the ends of two lengths of flex to be twisted together, a piece of the tape wound round the junction, and a match applied.

New High Temperature Tube Furnace

THE standard range of Wild-Barfield Tube Muffles of the single and twin tube types in use for many years were designed to give a maximum operating temperature of 1,050° C.

Tube muffles, capable of operating at temperatures up to 1,400° C (2,552° F) which will enable determinations of high alloy steels to be carried out, are now required by industry.

With this in mind, WILD-BARFIELD ELECTRIC FURNACES, LTD., Watford By Pass, Herts, have produced a new tube furnace, Model CC22, rated at 1·75 kW so designed that the exothermic reaction of high alloy steels does not harm the



This CC22 furnace accommodates two standard combustion tubes

furnace by excessive temperature on the elements.

The new furnace is designed for bench operation and is self-contained with built-in hand temperature control equipment and pilot lights.

The furnace takes two standard combustion tubes 1⅜ in. outside diameter. The heating chamber is 4 in. square and 6 in. heated length with well-insulated vestibules at each end to give the greatest practicable uniformity of temperature. It is claimed that, over a length of 4 in. uniformity within ±10° C (18° F) at 1,390° C (2,534° F) is obtained, this being a uniformly heated length ample for normal carbon and sulphur determinations.

In addition to the insulated vestibules, there is a ventilated compartment at each end, housing the connections to the heating elements. It is recommended that 24 in. combustion tubes should be used to ensure that the ends are reasonably spaced from the furnace itself.

The elements consist of silicon carbide rods. A tapped transformer is fitted in the base and a tap-changing switch, together with the ageing control switch and pilot lights, are easily accessible on one face of the plinth.

A Portable Hardness Tester

EXHIBITED at the current Factory Equipment Exhibition, the Indentometer is a new type of hardness tester which has been introduced by C. TENNANT, SONS AND CO., LTD., 4 Copthall Avenue, London E.C.2.

This instrument gives direct readings on the various Rockwell Scales, and is portable and speedy in operation.

The Indentometer is direct reading

Loads are instantly variable by a turn of a hand wheel; on the standard model loads of up to 150 kg can be applied.

A 120° cone diamond indenter is used, but alternatively either a $\frac{1}{16}$ in. or $\frac{1}{8}$ in. diameter steel ball may be utilised. A hydraulic pressure assembly is used, consisting of a diaphragm unit filled with fluid coupled to a finely calibrated dial pressure gauge mounted on the top of the instrument.

The depth of the impression is measured by a lever mechanism coupled to a direct-reading hardness recording dial on the face of the instrument which is graduated in units of 0·002 mm (or one point) of the Rockwell hardness scale.

TRADE PUBLICATIONS

ELECTRONIC EQUIPMENT.—Electronic measuring equipment for the laboratory and test bench of the radio and television engineer and details of the firm's variable transformers are featured in literature available from the industrial group of Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

TELEVISION AERIALS.—Television aerials and components are featured in a booklet issued by AB Metal Products Ltd., 16 Berkeley Street, London, W.1.

CONDUIT FITTINGS.—New Era fittings and accessories are listed in an abridged price list issued by Metway Electrical Industries Ltd., King Street, Brighton 1.

LIGHTING FITTINGS.—Lighting fittings for incorporation in the "Frenger" warm acoustic ceilings which were described in an earlier issue of the ELECTRICAL TIMES are displayed in a folder issued by Courtney Pope (Electrical) Ltd., Amhurst Park Works, Tottenham, N.15.

PLUGS.—Rubber-covered three-pin plugs, spring hinged sockets and plugs and rotary action shuttered sockets and plugs are illustrated on a recent Julius Sax and Co., Ltd., publication. The firm's address is 24 Commerce Road, Brentford, Middlesex.

RAILWAY CHARGES.—The scale of Railway Standard Charges which is published by The Railway and Shipping Publishing Co., Ltd., 12 Cherry Street, Birmingham 2, was recently revised and an up-to-date issue produced and published. This useful issue gives at a glance the standard rate for any class of goods up to 750 miles without calculations.

POWER DISTRIBUTION.—A revised price list for "Barduct" distribution equipment has been issued by Marryat and Place Ltd., 40 Hatton Garden, London E.C.1.

LIGHTING PROBLEMS.—These and their solutions form the subject matter of a brochure No.2, 1953, which has been published by the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.

ELECTRIC FENCES.—A new free booklet is now available on application to the Wolseley Sheep Shearing Machine Co., Ltd., of Wilton, Birmingham 6. This new fence booklet is copiously illustrated and covers all aspects of electric fencing.

INDUSTRIAL LIGHTING.—The Ekco range of industrial tungsten lighting equipment is featured in brochure TCF 52/1, issued by Ekco-Ensign Electric Ltd., 45 Essex Street, Strand, W.C.2.

NEW LITERATURE

High-Voltage A.C. Circuit-Breakers

by S. Gerszonowicz

THE importance of correct selection of high-voltage circuit-breakers cannot be over-estimated, yet the potential user, when investigating this subject is confronted with such a range of types and varieties that he finds it extremely difficult to make a rational assessment. This book is primarily written to aid in this difficult problem, and describes circuit-breakers which illustrate the application of all fundamental methods used in circuit interruption. The work consists of four main sections. The first deals with the basic phenomena involved; the second includes descriptions of various types of breaker, together with a review of operation and testing; the third deals with circuit-breaker standards and the last section is devoted to the problem of selection of breakers.

While the volume is well produced and illustrated, it is, as far as the text is concerned, somewhat difficult to read. This is possibly an inevitable consequence of the translation from the Spanish. Despite this, however, it is remarkably comprehensive in scope, and will certainly prove of great use to those who have the responsibility of appraising and selection of high-voltage breakers for power systems. Published by Constable and Co., 10 Orange Street, London W.C.2, 454 pp., 5½ in. by 8½in. Price 63s.

The Cathode-Ray Oscillograph in Industry

by W. Wilson

THIS, the fourth edition of this volume since 1943, shows well how rapidly the technique of electronic measurement by means of cathode ray oscillographs has extended in the industrial field. The instrument is considered in its widest sense to include the electron microscope to which much more attention is given in this edition than in its predecessors. The text generally has also been brought up to date to include much recent development work. Owing to the unfortunate death of Dr. W. Wilson which occurred during the revision of the proofs of this volume, the work was completed by Mr. G. L. G. Jeans. Published by Chapman and Hall, 273 pp., 5½ in. by 8½ in. Price 36s.

Electric Wiring Diagrams

by W. Perren Maycock, M.I.E.E.

IN its fourth edition, prepared by Mr. A. Serner, B.SC., A.C.G.I., A.M.I.E.E., this classic has been extended to give diagrams and descriptions of some important fluorescent lamp circuits. Essentially, however, the book is unchanged. It remains a clearly presented pocket-book of connection diagrams for a wide range of apparatus, and for many different circuits in house wiring. Published by Pitman, 156 pp., 7½ in. by 4¾ in. Fourth edition, price 8s. 6d.

A Stitch in Time . . .

MAINTENANCE of electrical equipment is an essential operation in keeping factory production at a high level, and managements are coming to recognise this increasingly. They and their staffs should welcome, in consequence, this handy booklet which packs into a small space some most useful notes on electric motor control gear maintenance. Although prepared by a well-known manufacturer, its suggestions are applicable to gear of all makes, and there can be few maintenance men who will not welcome its possession. Published by Igranic Electric Co., Ltd., Bedford, 33 pages, 8 in. by 5 in. Gratis.

Tensors in Electrical Machine Theory

by W. J. Gibbs, D.SC., M.I.E.E.

FOR the design engineer requiring an insight into the possibilities of tensor analysis as a mathematical tool applied to electrical engineering, this volume should prove most valuable. It is by no means easy reading, but it does deal gently with the engineer who is not readily at home with the mathematical language in which tensors are generally developed. Nevertheless, the essential study of differential geometry is not shirked as a preliminary to the application of tensors to rotating machines as combined electrical and mechanical systems. Published by Chapman and Hall as one of the B.T.H. "Advanced Engineering Textbooks" series, 238 pages, 8½ in. by 5½ in. Price 30s.

BOOKS RECEIVED

Selected problems in the preparation, properties, and application of materials for radio purposes. Produced by the Radio Materials Committee of the Radio Research Board, D.S.I.R., this book is based on the work of study groups considering ceramics, organic polymeric dielectrics, magnetic materials and semi-conductors, outlining existing knowledge and stating the most urgent research problems. Radio research, special report No. 25, published by H.M.S.O. for D.S.I.R., 24 pages, size 9½ in by 6 in. Price 1s. 6d.

Industrial Brazing, by H. R. Brooker and E. V. Beatson. Full length study of brazing as a process in metal fabrication. Published by Iliffe and Sons, 344 pages, 8½ in. by 5½ in. Price 35s.

The Induction Motor, by H. Vickers. Comprehensive study of theory, design and application. Published by Pitman, 531 pages, 9 in. by 6 in. Second edition, price 70s.

Electricity in the Garden, by G. Gerard. Practical instruction book for the gardener. Published by Collingridge, 125 pages, 8½ in. by 5½ in. Price 15s.

Television Receiver Design, Vol. I, by A. G. W. Uitjens. Monograph on I.F. stages. Published by Cleaver-Hume Press for Philips Technical Library, 173 pages, 9 in. by 6 in. Price 21s.

The WEEK in NEWS

Comments on Electrical Exhibition

Business Good—Many Visitors from Overseas

GENERAL opinion during the lull of relaxation following the storm of preparation, organisation and running of the second Electrical Engineers Exhibition, was that the first really large-scale venture was an unequivocal success. After last year's disappointing weather which undoubtedly kept many people away on one of the two days of the show, the conditions this year were far more clement and ensured a steady stream of visitors. Official attendance figure over the four days was 14,250, and among those was a most encouraging proportion of overseas engineers. Countries represented included the U.S., Australia, S. Africa, Pakistan, Holland, Denmark and Germany.

It has been announced that the exhibition will be repeated in 1954. Mr. P. A. Thorogood said after the exhibition, that firms not represented had already asked for space to be reserved for 1954. The majority of exhibitors reported 100% success and excellent business, and many said the exhibition served them better than the B.I.F. A few said the show should be kept solely for the trade and at its present size.

The two medallions awarded for the best technical exhibit and the best labour-saving device were awarded to Lancashire Dynamo and Crypto for their wire taping machine and to Santon Ltd. for their Otter controlled immersion heater.

LONDON BOARD'S REORGANISATION PLANS UNDER WAY

IN the major reorganisation of the South Western sub-area of the London Electricity Board, which we exclusively noted in our January 22 issue, the Board is now dealing with the location of the staffs. The Board aims to locate the Battersea/Wandsworth East and West district manager and his staff at Lavender Hill, front building (District 'A'). For District 'B,' the Wimbledon/Mitcham district manager and his staff are to be at Durnsford Road, Wimbledon. It is proposed to place the existing sub-area accountancy staff in one building other than Lavender Hill.

The immediate proposals are to transfer the costing staff from Durnsford Road to East Hill, and the district staff from Mitcham, together with some sub-area staff from East Hill, to Durnsford Road. More than two years ago the Board requested the Battersea Borough Council to vacate the two floors they occupy at Lavender Hill, and now the Board's need for this space becomes more urgent.

RISE IN TARIFFS UNAVOIDABLE IN EAST MIDLANDS

INCREASES in tariffs, other than those incorporating a fuel clause, has been decided upon by the East Midlands Electricity Board, following the 10% rise in the cost of coal. The revisions operate from this month. Under the standard domestic tariff, the charges for the first block of units is raised by ½d. to 4½d. per unit, and for excess units from ¾d. to 1d.

In the alternative block industrial tariff (without a coal clause) the price of the first 3,000 units p.q. is raised from 1¾d. to 2d., and for the second 3,000 units from 1⅝d. to 1¾d., while for all in excess the charge remains at 1½d.

In addition, all existing flat rate or block tariffs for lighting are increased to 4½d. p.u. where the present tariff is below that figure. Unit charges on two-part, flat rate, or block tariffs for purposes other than lighting are raised to 1d. p.u. This move is pending the introduction of standard tariffs later this year for farms, commercial and miscellaneous premises. The Board estimates that these changes will produce an extra £788,000 annually.

The First Half-Century

At the annual dinner and smoking concert of St. James's and Pall Mall Electricity Supply Company Mr. Percy Still and Mr. Brice propounded with becoming gravity the theory that inasmuch as good sportsmen were always good workers too, it would conduce to the public interest were the electric supply concerns to engage no man who couldn't play cricket. Mr. Still would almost go farther than that and have every one sacked who didn't play the game, only in that case he himself would lose his present appointment. Therefore he didn't press the matter, but he did think that the prime duty of every board of directors was to buy up enough land—no matter if it cost thousands—to provide a practice pitch close to the works.—*From our issue of April* 2, 1903.

Importance of the Cooking Load

More Papers at Demonstrators' Conference last week

ALTHOUGH we were able to include a report of Lord Citrine's remarks at the opening of the annual conference of Electrical Housecraft Advisers and Senior Demonstrators, it was impossible to refer to the many other papers at the conference. Among these was the talk on "The Importance of the Cooking Load" given by Mr. N. F. Marsh, chief commercial officer, E. Midlands Board. As the system for domestic electricity revolved around extensive use of power for cookers and other appliances, it was, he said, essential that the high rate of consumption be maintained and increased to keep prices down. Mr. Marsh spoke also of the "electricity v. gas competition" on new housing estates. Local authorities were inclined to give the lighting, radio and TV and other small apparatus load to electricity boards whilst leaving cooking and water-heating to gas boards. That was not a fair distribution of the load and it was therefore essential that all houses be adequately wired for cookers and water-heaters. Tenants should be given the choice. Mr. Marsh considered it advisable to have a simple hire scheme to cater for consumers who could not afford hire purchase and could not take advantage of electric cooking without simple hire models.

The subject of Commercial Catering was dealt with by Mr. E. M. Ackery, who commented chiefly on the planning of kitchens. The ideal, he said, was to have a situation where the hotel staff could carry out their work in the minimum time and effort. In that connection it was important to study the sequence of events—storage, preparation, cooking, tabling and service—and arrange appliances accordingly.

Miss E. M. Eaves spoke later on "The Art of the Demonstrator" and Eileen Cassidy on "Practical Side of Commercial Catering."

A Good First-aid Record

IT is a remarkable fact that for the third successive year the same teams have won the National Competition of the B.E.A.'s Ambulance Centre. This triumph goes to Sussex. Winners of this year's competition, held last week, were the Worthing team in the men's section, and the Mid-Sussex women's team. Lord Citrine attended again to present the winners with trophies and individual plaques.

Radio and TV Sales Fall in January

AVERAGE number of radio and television sets sold per shop fell considerably during January according to the latest index issued by R.T.R.A. Sales of radio sets averaged only 6·8, a decline of 3·44 on the previous month and the lowest January figure recorded. Comparative figure last year was 9·05. As regards television sales, these fell from 15·35 in December to 10·03 in the month under review. The January 1952 average was 12·51.

Mr. V. W. Dale, Dame Caroline Haslett and Lord Citrine at the E.D.A./E.A.W. Conference

Fuse Blowing Causes Train Accident

IN a report published last week on a collision between an electric train and a light engine at Guildford last November, the conclusion is reached that failure of the air brake system led to the accident. This in turn is traced to the blowing of a fuse on the compressor governor, which in certain circumstances stops the air compressor. The accident was stated as the first due to the failure of a Westinghouse brake on electrified stock.

The investigation into the accident is of interest, since x-ray photographs were used to show that the fuse had probably blown on a medium overload, such as might be caused by a current surge when passing over gaps in the third rail.

I.E.S. HEARS ABOUT LIGHT AND PLANTS

THERE was a slight departure from the more usual papers on light and lighting read before the I.E.S. Birmingham Centre, when Prof. R. H. Stoughton presented his discourse on "The Effect of Light on the Growth and Development of Plants" recently. The subject itself is not a new one, but it was novel to I.E.S. members. Briefly, the lecturer referred to germination, the rate of growth, photosynthesis and general development. He explained the sundry light requirements of various seeds and demonstrated how a plant's rate of growth was reduced by light in proportion to its intensity. Prof. Stoughton also explained how a decrease or increase light on a plant determined direction, quality and quantity.

OFFICIAL PUBLICATIONS

HEATING APPLIANCES (Fireguards) Regulations. S.I. 526 (England & Wales), and S.I. 524 (Scotland). H.M.S.O. 3d. each (*see page* 630).

RAILWAY ACCIDENT, Guildford. Report of Brig. C. A. Langley (*see page* 651). H.M.S.O. 2d.

CIVIL ESTIMATES. Class IX Transport, Fuel, Power and Industrial Research (*see page* 653). H.M.S.O. 3s. 6d.

FACTORY INSPECTOR'S REPORT for 1951. Command paper 8772 (*see page* 635). H.M.S.O. 6s. 6d.

BRITISH STANDARDS. B.S. 1961: Enamelled Round Copper Wire (Oleo-Resinous Enamel) Metric Units.

Australian Tariff Change

AN announcement has been made in Canberra concerning a number of amendments to the Australian Customs Tariff, 1933-52. The alterations became effective on March 6. Electrical items included among the changes are confined to ironing machines and washing machines. In these cases the new British Preferential Tariff is 15% compared with 22½% before.

Coronation Calendar

IN keeping with the high standard set by previous calendars distributed by Metrovick, is the latest produced for Coronation year. It is, of course, the company's practice to compile two calendars each year, one to run from October to September and the other, a smaller one, from April to March. This latter is enhanced by a delightful portrait of H.M. the Queen.

India's Need for Heavy Electrical Plant

ONE of the largest Overseas Economic Surveys is used by the Board of Trade in the recent publication in the series on India. As the overall size is bigger than most in the series so also is the amount dedicated to electricity and allied projects. Reason for this is the draft outline of the Five-Year Plan and the Colombo Plan, under both of which are extensive development schemes.

Large sums are to be spent on increasing the availability of power, mainly by hydro-electric schemes linked with irrigation projects. According to the draft, 451 crores of rupees are to be set aside for bringing 8·7 million acres of land under irrigation and for generating 1·1 million kW of additional power. Over fifteen years it is anticipated that further projects will increase power generation by 7 million kW. It is disputed, however, whether large-scale electricity projects will be undertaken unless there is an existing demand for highly industrialised areas.

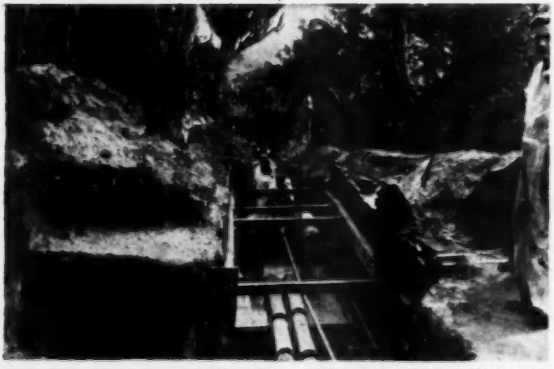
Bearing these plans in mind, it is easy to recognise India as an excellent market, especially for heavy plant. Demand for large equipment has to be satisfied by imports at present, although proposals have been submitted for the establishment of her own factories. Biggest demand in future years is likely to lie with generating equipment, control and switchgear and transformers. Another sphere in which the demand is likely to be large is for refrigeration equipment.

S. Wales Farmers Want to Meet Lord Citrine

SOUTH WALES farmers are determined to press their grievance about the lack of electricity in rural areas. Representatives have been appointed by the Welsh committees of N.F.U. to meet Lord Citrine, and they are to urge a larger allocation of capital to the Area for development during 1953-54. Main protest comes from Carmarthen who allege that the original excuses were lack of capital, restrictions on capital expenditure, and too great a pressure on service lines. Now, they maintain, it is said that farmers are not using sufficient electricity to justify the cost of development.

British Cables Laid in Natal

DURBAN'S Alice St. major substation and the Electricity Supply Commission's new 132/33 kV step-down station at Springfield on the Umgeni River, have recently been linked by a 33 kV oil-filled cable installation. Two 0·02 sq in 3-core cables and a common 6-core, 8-pair telephone pilot cable were laid along a route of about 3½ miles covering much wild bush country and several steep inclines. The two 33kV cables, manufactured by Pirelli-General Cable Works, Ltd., form part of the interconnector cable system between the existing power station at Congella and the new Umgeni station at Pinetown. Springfield substation is the terminal of a double circuit 45MVA 132kV o.h. line from Umgeni. Loads of up to 20MVA will be supplied from Alice St. and Springfield. Existing supplies from Congella and Alice St. are already carried by two 0·25 sq in "H" type 33 kV Pirelli cables, and a further order for some 6,200 yd of 3-core 0·20 sq in oil-filled cable has been received for further extensions.



Cable laying in progress in the bush country of Natal. The 33kV cable is being hauled into the joint pit

NEW ALUMINIUM LAMP STANDARD

THE lamp standard illustrated in the accompanying drawing has been designed in recent weeks by Birmingham City's architect, Mr. A. G. Sheppard Fidler. It is of novel construction and intended for roads and areas not covered by normal street lighting columns. Such localities would be the communal gardens and internal roads between blocks of flats. It is hoped that their first use will be in the city's Duddeston and Nechells Redevelopment area where they will illuminate paved areas and gardens around 12-storey blocks of flats.

The standard itself comprises a tapered silver anodised aluminium tube, set in and insulated from a cast iron base. External diameter of the base is 6½ in. There is also a removable access panel, facilitating easy approach to the main switch, time switch and sealing chamber, all fixed to a teak backboard. Shade is of spun aluminium and silver anodised. Overall height is nearly 14 ft., and light source is 12 ft above the ground.

Aluminium lamp column designed for private roads and gardens, by Birmingham's city architect

COPPER PRICE DOWN

IT was announced by the Ministry of Materials last week that the price of electrolytic copper has been reduced from £285 to £280 a ton delivered consumers' works. The decrease is effective from March 26. At the same time the discount on Ministry sales of blister copper has been increased by £1 17s. 6d. from £5. Other discounts and premiums remain unchanged.

Apprentices' Dinner

THE Apprentices' Association at the G.E.C.'s Witton works, Birmingham, held their annual dinner recently. About 350 apprentices, ex-apprentices and their guests attended the dinner itself, a short play and the annual presentation of awards. The prizes were given to four "best apprentices," and there was also the Apprentices' Cup and Best All-round Sportsman's Cup awarded to Mr. A. B. Woolley and Mr. B. Boffey.

British Subsidiary Formed in Canada

A SUBSIDIARY company has been formed in Canada by Associated Insulation Products Ltd. It will be known as Micanite Canada, Ltd., and offices will be at Granby, Quebec. At present the new firm will market electrical insulation products made by their partners in London and New York, but eventually it is proposed to manufacture such goods in Canada.

MINISTRY OF FUEL 1953 ESTIMATES

OFFICIAL estimates for 1953-54 give £3,491,200 as the total cost of the Ministry of Fuel and Power. Of this, some £2 m. is attributed to salaries. The Electricity Division of the Ministry is estimated to account for £39,700 of this latter total, a decrease of £100 on the 1952-53 figure. The staff of the Division is given as 45, including six engineering inspectors and meter examiners. Included in the miscellaneous receipts which will offset the cost of the Ministry by £538,000 is a sum of £62,500, estimated for receipts for examining and certifying electricity meters.

Norfolk's Committee for Special Events

READERS may recall the formation last year of the Norfolk Electrical Social Committee. We have just heard from the committee that the venture has been outstandingly successful and as a culmination of the first year's work a dinner-dance was organised at the Lido Ballroom, Norwich.

The committee was formed with support from the Norfolk Electrical Development Circle, the E.C.A., and the Eastern Electricity Board. Its purpose was to organise, at the request of any one of the constituent bodies, social events intended to foster good relations in the industry. The latest function was under the auspices of the E.D.A. Local contractors, representatives of manufacturers and staff of the Electricity Board attended in good numbers. Chairman was Mr. H. P. Hancock (B.I.C.C.) and guests included the Lord Mayor and Lady Mayoress of Norwich, and the Sheriff of Norwich.

Council Seeks Own Electrical Dept.

A MOTION that the council should set up a direct labour electrical department was considered at a recent meeting of Cumnock (Ayr) town council. It was stated that there was great difficulty in getting local contractors to carry out repairs expeditiously and a direct labour department would ensure that work was speeded up. By the employment of one journeyman and one apprentice electrician, there would be a saving of some £250 a year. A local contractor, moving a direct negative, said there were few repairs required, but those outstanding had been done quickly. An electrical department was a good thing in all big concerns, but the council should consider contractors in the area. An amendment that the matter be submitted to a full meeting for discussion was agreed.

New Atomic Factory in Cumberland?

SUGGESTIONS have been made that a new atomic energy factory to be built in Cumberland will be used eventually for the generation of electricity. We understand that preparations are being made to establish a factory near Sellafield, where the atomic explosive, plutonium, is manufactured. Rumour has it that the building will house a giant breeder reactor, and breeder piles should be capable of generating electricity while producing more fuel than they can consume. It will be recalled that the Minister of Supply stated in the House last January that Britain intended to build such a breeder reactor in the near future. A small experimental pile has been built by the Americans, and a similar pile is nearing completion in this country.

Main Road Lighting at Port Elizabeth

AN admirable illustration of main road lighting has reached us this week from Port Elizabeth, S. Africa. The lanterns used were the popular "S.O. Fifty"-type made by Metropolitan-Vickers Electrical Co., Ltd. These have proved successful in installations in this country, but their main characteristics, being of all-plastic totally enclosed construction, light in weight and not needing painting or similar maintenance, makes them suitable for tropical or sub-tropical conditions. The Port Elizabeth scheme comprises 168 lanterns housing 140 W sodium discharge lamps. They have been mounted at a height of 24½ ft. and at intervals of 110 ft on straight stretches and 100 ft on the bends.

BRITAIN'S NEW ATOM SORTER AT HARWELL

MACHINES known as electromagnetic separators are now being used to provide valuable new atomic materials to scientists in this country, the Commonwealth and Europe, at Harwell. These machines, we understand, not only separate the atoms of an element but can also reassemble them into usable quantities. After separation of the atoms much important research work becomes possible. There are two electromagnetic separators at Harwell now. The bigger has been made largely automatic by the aid of numerous electronic controls. So far 20 elements, including most of the common metals, have been separated into their constituent isotopes. Some 200 consignments have been used at the research establishment or sent to research institutions and universities in other parts of the British Isles, the Commonwealth and Europe. About 60 different isotopes are in stock to meet future requests.

A section of the lighting installation along the Kloof and Mount Roads, Port Elizabeth, where Metrovick equipment was used

GERMAN TRADE FAIRS

A BUSY year of exhibitions has already started in the West German towns of Cologne, Frankfurt and Hanover. International spring fairs specialising in household goods and hardware took place towards the end of last month, to be followed in the autumn by similar exhibitions between August 30 and September 1 at Cologne, and between September 6 and 10 at Frankfurt. The Cologne shows at least appear good centres for household electrical appliances. About 250 miles away at Hanover, the German Light Industries Fair has been held, but the Heavy Industries Fair is due to open on April 26 for 10 days. The electrical industry will be well represented at that show, with almost every type of equipment from large generators and transformers, to small electric lamps being exhibited.

NEWS IN BRIEF

New type concentric diffuser loud speakers have been installed at Central Station, Glasgow, to improve sound distribution of public announcements.

Indian apprentices of Brush Electrical Engineering Co., Ltd., entertained the Indian High Commissioner when he visited Loughborough recently.

Aerialite, Ltd.'s lecture "TV Aerials—their Design, Construction and Erection" has been repeated in Newcastle.

Nearly all the electrical installations on the extensive Sharp End estate, Birmingham, have been carried out by the Etna Lighting and Heating Co., Ltd., using Ediswan cables.

Demand for regular overhaul of electrical equipment in hairdressing saloons has been made by Worcestershire Federation of Women's Institutes.

A Bexley (Kent) radio dealer cashed in on a visit by a burglar who stole an Ekco portable radio set. After boarding up his window, he pinned up a poster asking the public if their choice would be the same as the burglar's.

(continued on following pages)

Merseyside and N.Wales Electricity Board arranged with Mr. Philip Harben, the TV cook, to give two cookery demonstrations in Liverpool last week.

Yet another branch of E.A.W. has been, formed at Northampton. Chairman is Mrs. E. Slinn.

The fifteenth North London Exhibition, established in 1926 originally, is to be held at Alexandra Palace, London, between April 15 and 25.

Statutory control of maximum prices for steel bolts, nuts, screws and rivets has been terminated by the Ministry of Supply.

This year's reunion for the Edmunsons Group will take place at Holborn Restaurant on April 24 at 6 p.m.

Twelve outstanding displays were produced by first-year students in a window-dressing competition organised recently by Smiths Electric Clocks Ltd.

Nearly 1,500 visitors took advantage of W. T. Henley's Telegraph Works' invitation to tour their North Woolwich factory on an Open Day recently.

At the third one-day management conference organised by the Southern Electricity Board at Maidenhead, Sir Charles Renold gave an informative address on "The Aim of Joint Consultation."

Questions in Parliament . . .

Industrial Efficiency

The setting up of two joint committees to advise on the study of human factors in industry has been approved by the Ministry of Works, it was stated in the House last week. The inauguration of these bodies was recommended by the Department of Scientific and Industrial Research, and terms of reference were published in he Department's 1951-52 report. Chairman of the joint committee on individual efficiency in industry is Sir Frederic Bartlett, and his opposite number on the committee on human relations in industry is Mr. A. B. Waring.

Grass-drying Experiments

Secretary of State for Scotland was asked about progress in experiments in grass-drying by electricity, how far the method had been successful and economic, and what facilities were being given to small farmers and crofters who could use the system. Replying, Mr. J. Stuart stated that the N. of Scotland Hydro-Electric Board had been conducting these experiments for several years. Additional plants were being provided this year and it was proposed to experiment with a plant at Plockton which could be used by small farmers and crofters on a community basis. The process was still in the development stage, he added. The questioner was Mr. Grimond.

Monopolies Commission

Replying to Mr. Daines, the President of the Board of Trade said reports of the Monopolies Commission were laid before Parliament as quickly as possible. He had been asked what steps had been taken to see there was no delay in their publiçation.

Machinery Exports

Mr. Janner asked last week if the President of the Board of Trade would consider issuing blanket export licences up to a given limit to cover immediate supplies of essential spare parts for servicing abroad the various kinds of British machines. He alleged that the system of export licences for spare parts was having an adverse effect on the export trade since it retarded prompt service of machinery to overseas buyers. Mr. Mackeson stated that in general spare parts for servicing machinery could be exported without licence, but for security reasons uncontrolled exports could not be allowed in all cases. Applications for blanket licences to cover urgent demands would be considered.

Australian Tariffs

The Australian Tariff Board's report on internal combustion engines had been received and was being studied by the Government departments concerned, said Mr. P. Thorneycroft last week. Mr. D. Jay had commented that if Australia raised tariff rates on these and textile exports it would be a serious matter for the British industries, and asked if representations were to be made to the Australian Government.

Scientific Research

The Prime Minister has declined to appoint a senior Minister in the House of Commons with the main responsibility of encouraging scientific research and its application to industry. He said responsibility was at present vested in the Lord President of the Council.

Coal and Freight Charges

The inflationary spiral resulting from increases in coal prices and freight rates was the subject of a question by Mr. Beswick. He asked whether any steps were being taken to meet the situation caused by the acceptance by the Ministry of Transport that coal price increases caused rises in freight charges, and similar acceptance by the Ministry of Fuel and Power that freight rates caused coal price increases. Mr. Churchill, replying, stated that coal represented only about one-tenth of railway operating costs. Upward price trends could only be reversed by increased production of coal, and efforts were being made continually to bring that about.

Electric Supply News . . .

Blyth (Northumberland)

The town council has decided not to allow waste from the proposed Cambois power station to be tipped in the borough. The county planning officer has informed the council that tipping into the sea may be decided upon.

Llanelly

Replying to complaints regarding the proposed charges for providing a supply in the Trimsaran and Pontyates areas, the South Wales Electricity Board has pointed out that the cost of this work would be about £4,000, but it was proposed to recover only £456 from the residents concerned.

Newcastle-on-Tyne

The Minister of Fuel and Power has rejected the objections of a farmer at Stocksfield to the proposal of the North Eastern Electricity Board to carry a power line across his farm (to which we referred on February 12). Commenting on the rejection, the farmer, Mr. Batey, has said that it was expected, adding that the Minister's letter announcing the decision omitted reference to the cause of the objection—the "ridiculous" charge the Board was demanding to carry a supply a very short distance to the farmer's grass-drying plant and the farm generally. But the matter is not being allowed to rest there, we gather, for the National Farmers' Union, the Country Landowners' Association and the Land Agents' Society have called a joint meeting to decide what the next step shall be to deal with the question.

Rutherglen

A £14,195 scheme of reinforcement to meet the increasing load on the electricity network in Rutherglen has been approved by the South West Scotland Electricity Board.

S. E. Scotland

The problem of electricity development is more acute on the Borders than elsewhere in the south-east area, it is stated in a communication addressed by the South-East Scotland Electricity Consultative Council to the Roxburgh National Farmers' Union who were represented at a conference held at Kelso recently when the board's policy for the southern sub-area was explained. The council have expressed their concern at the adverse effect the lack of electricity supplies is having on food production.

Shrewsbury

For the past year the local Housewives' Association has been protesting against a decision of the Midlands Electricity Board not to issue meter cards to consumers in the sub-area. Now the Association has pointed out that on the consumers' electricity bills the date of reading the meter is not given. Ald. Lewis, chairman of the Board, has stated that the date of meter reading is omitted from accounts in the interest of economy as, particularly with a mechanical system of billing—just about to be introduced in the Shrewsbury district—complications arise in stating the date. He points out that a consumer can, however, always check his meter to see that the bill is not more than the reading of the meter at the time the bill is received.

Upholland

The council have approved proposals submitted by the district engineer of the North Western Electricity Board for the erection of h.v. and l.v. overhead lines to supply Ashurst's Farm and Houghton's Farm, Skelmersdale, and a proposed installation in Grimshaw Lane, Upholland. These extensions will also provide a supply for Spencer's Lane and Digmoor areas.

LIGHTING SCHEMES

Aberdeen.—The Corporation Watching and Lighting Committee have approved a new fluorescent lighting scheme for Union Street, to cost £13,800, and a scheme for mercury vapour lighting on the North Deeside Road from Mannofield to the city boundary, to cost £2,000.

Brechin.—T.C. has approved the installation of improved lighting throughout Class I roads in the burgh, at an estimated cost of £5,800.

Brighouse.—T.C. has approved in principle the installation of street lighting at Rastrick, at an estimated cost of £2,000.

Caistor.—The Parish Council has decided to change street lighting from gas to electricity.

Letchworth.—Street lighting is to be improved at a cost of £15,000, to be spread over a period of three years. The surveyor is to prepare a scheme utilising sodium lamps.

Stratton St. Margaret.—The Parish Council proposes to borrow £1,000 for the provision of street lighting at Meadowcroft estate.

Sunderland.—The T.C. has been asked to approve an £18,125 scheme for autumn illuminations—£6,025 more than for last year.

Sunningdale.—The Parish Council is seeking an early reply from the M.o.T. to the Council's request for approval to change over street lighting to electricity.

Worksop.—T.C. recommended to approve reorganisation of lighting in Carlton Road, at a cost of £3,210.

York.—Housing Committee proposes that application be made to borrow £5,272 to cover the cost of street lighting at Moor Lane and Askham Lane estates.

Company Activities . . .

Brush Electrical Engineering Co.

No final dividend is to be paid for 1952, so the total distribution is 4% (*10%*). The reason for this is stated to be due to the exceptional loss on Indian contracts and the need to conserve working capital. The group net profit, before taxation, is £1,174,767, which is about £500,000 lower than the previous year. After charging taxation the net profit becomes £425,914 (*£588,552*). From this balance is deducted the loss to date on initial contracts for tube wells in India, after deducting £195,200 in respect of tax relief thereon, of £308,970, leaving £116,944. In addition it has been deemed appropriate to write off over three years the heavy tooling expenditure on new diesel engines, which for 1952 amounts to £95,669. On the contract for 965 wells in the Punjab, United Provinces and Uttah Pradesh, it is stated that progress was not satisfactory, and following investigation and a report by the company's joint auditors it is necessary to make provision for a loss of £504,170 up to December 31 last, and an estimated further loss to the completion of the contract of £180,000.

Bylock Electric Ltd.

The further improvement in trading is amply reflected in the results for the year ended July 31 last, as may be seen from our accompanying table. Mr. C. A. Mathes, the chairman, states that from experience based in the first six months trading of the current lead, comparable results are expected

Year to July 31	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earn'd	Paid	High	Low
1948	—421*	—7,294*	—	—	22/6	5/-
1949	27,259	8,120	98*	—	7/6	3/9
1950	13,513	292	3	—	4/11	2/9
1951	13,553	1,625		50	5/4	3/1
1952	40,053	24,432		50	6/6	2/9

* Loss.

with the last financial year, although, of course, it is impossible to predict conditions during the next few months. The satisfactory arrangements made with the Inland Revenue authorities have been concluded and he confidently looks forward to the time when the whole liability will have been dealt with.

Newman Industries

The results for the year ended December 31 last are but little changed from those of the previous year, as will be seen from our table. In view of the more competitive nature of the electric motor industry, this may be considered reasonably satisfactory. The amount carried forward, £102,954, is almost the same as before, but there is a further £4,409 placed to reserve as against nil for the previous year.

Year to Dec.31	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earn'd	Paid	High	Low
1948	165,099	37,828	19	17½	7/9	6/3
1949	139,663	21,845	10	10	6/10	3/-
1950	95,146	3,068	1	6	4/3	2/7
1951	189,146	26,761	14	10	3/10	2/6
1952	183,776	24,320	13	10	2/11	

J. Stone & Co. (Holdings), Ltd.

It is proposed to issue 171,543 new 'A' Ordinary shares at 50s. each to holders of Ordinary and 'A' Ordinary stock on a one-for-seven basis.

Telegraph Construction and Maintenance Co.

A substantial increase in trading profits for 1952 is reported. In view of the year's good results, the directors have recommended a special cash bonus of 1% rather than an increase in the ordinary dividend. The Rt. Hon. Lord Colgrain, chairman,

Year to Dec.31	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earn'd	Paid	High	Low
1948	345,274	151,589	35	10	52/6	42/-
1949	357,132	144,698	27*	9*	43/3	35/6
1950	390,938	142,443	26	11†	43/6	35/3
1951	525,076	166,306	32	10	47/1	38/-
1952	694,767	229,693	22	8½‡	29/1	22/1

* Capital bonus 25%. † Including 1% for 1949 from dividend reserve. ‡ Final of 3½% on increase capital, plus 1% cash bonus.

states that during the past two or three months orders have been coming in rather more slowly than of late, but the company is fortunate in starting the year with a substantial volume of orders in hand. But profit rates, particularly on orders from overseas, are tending downwards, due to competition from other countries, he warns.

Wolf Electric Tools (Holdings)

An increase in profits and dividend results from operations in the year ended December 31 last. The group profit, after taxation, is £51,775, compared with £30,837 for the previous nine months, when the dividend, at 10%, absorbed £16,716. For last year the dividend is raised to 15%, absorbing £25,074.

Dividends Declared

British Insulated Callender's Cables, Ltd.—Interim of 2%.

Joseph Lucas (Industries).—Interim dividend of 1½% (*same*).

Skefko Ball Bearing Co.—Final Ordinary of 13½%, making 18¾% tax free (*same*). Profit for 1952 is £353,597 (*£317,161*), after taxation and placing £250,000 (*same*) to reserve for possible reductions in stock values.

Superheater Co.—Final of 25%. Net profit £179,189 (*£164,412*).

Telephone and General Trust.—Final Ordinary of 5%, making 8% for the year (*same*). On the 'A' Ordinary the dividend is again 8%. Group net profit is £194,969 (*£148,806*).

Commercial Information

CONTRACTS OPEN

HOME

April 3.—Carlisle. Electrical installation at Harraby junior school. City Surveyor, Fisher Street.

April 3.—Sutton Coldfield T.C. Supply and erection of 63 mercury discharge lamps on concrete columns and brackets to Group A standard along Chester Rd. Borough Surveyor, Council Offices. Deposit £2.

April 4.—Amble (Northumb.) U.D.C. Electrical installation in 26 houses to be built on Links estate. Surveyor's Dept., Council Offices.

April 4.—Kilmarnock T.C. Supply of electric lamps required during year ending May 15, 1954. Burgh Surveyor's Office, 11 London Road.

April 4.—Peterborough. Lighting and power installations in 60 houses on Dogsthorpe North estate. Applications by above date to F. J. Smith, City Engineer and Surveyor, Town Hall. Deposit £2 2s. (See March 26 issue.)

April 4.—Ryton (Dur.) U.D.C. Electrical installation in 44 houses at Greenside. Surveyor, Ryton Tower.

April 6.—Louth T.C. Floodlighting of parish church of St. James's at a cost of £450 (approx.). John T. Chenery, Town Clerk, Town Hall.

April 6. — Newbury R.D.C. Wiring of 60 houses on various sites. Surveyor, Phoenix House, Bartholomew Street.

April 7.—Silsden U.D.C. Erection of 43 concrete standards and supply and fitting of lanterns for mercury street lighting to Class A standard. Council's Surveyor, Council Offices. (See March 26 issue.)

April 8.—Bath. Electrical installation in 19 flats at Kingsmead. City Planning Officer and Architect, 7 North Parade Buildings. Deposit £1 1s.

April 8.—Lisburn U.D.C. Supply and installation of four electric motors to pumping plant at Sewage Disposal Works, Tullynacross. Surveyor's Office, Town Hall.

April 8.—Lytham St. Annes T.C. Installation of mercury discharge street lighting units to class A standard—about 89 units. Borough Engineer and Surveyor, Town Hall.

April 8.—Manchester. Electrical installation in waste utilisation plants at Grimshaw Lane Cleansing Depot, Newton Heath. City Architect, Town Hall. Deposit £1 1s. (See March 19 issue.)

April 8. — Newcastle-on-Tyne. Electrical installation in 84 flats on Montagu estate and 72 flats on Blakelaw estate. City Architect, 18 Cloth Market.

April 10.—Crosby T.C. Installation of sodium lighting to Group A in College and Coronation Rds., about 2,080 yd. Names to Borough Engineer and Surveyor, Town Hall, Waterloo, Liverpool 22.

April 10.—Haslemere (Surrey) U.D.C. Supply of street lighting equipment for group B lighting: (*a*) 100 columns, (*b*) 100 lanterns, brackets, lamps and control gear for 60W sodium units, (*c*) erection of columns, and installation of equipment. Surveyor, Council Offices.

April 10.—Kingston - on - Hull. Electric light and power installation to Aldwark Manor, near Easingwold. City Architect's Dept. Deposit £1 1s.

April 10.—Lancashire. Electrical installation and supply of kitchen equipment to Longridge Woodville special school. Applications by above date. County Architect, County Hall, Preston.

April 11.—Swansea T.C. Contractors wishing to tender for electrical installation at Penlan Multilateral school should apply to Borough Architect, The Guildhall, by above date. Deposit £2. (See March 26 issue.)

April 13.—Northampton T.C. Installation of street lighting comprising 69 columns with fluorescent lamps, and 54 with tungsten mercury lamps. Borough Engineer, Guildhall. Deposit £2 2s. (See March 26 issue.)

April 13.—Portadown (N.I.). Electrical installation in new classrooms and alterations to existing installation at Portadown College. J. R. W. Murland, Consulting Engineer, 13 Wellington Place, Belfast. Deposit £3 3s.

April 13.—Wisbech (Camb) T.C. Installation of electric wiring in houses on New Drone and Elm Rd. estates. Borough Engineer, Town Hall.

April 14.—Bilston T.C. Supply and erection on various roads of about 56 250W H.P. mercury discharge lamps on 25 ft concrete columns, 29 80W H.P. fluorescent mercury discharge lamps on 15 ft concrete columns, and five 100W metal filament lamps on 15 ft concrete columns. Borough Engineer, 20 Wellington Rd. Deposit £3 3s.

April 14.—Islington B.C. Installation of fluorescent lighting, wiring, etc., in Essex Rd. library. Borough Engineer and Surveyor, Town Hall, Upper St., N.1. (See March 5 issue.)

April 14.—Radcliffe T.C. Installation of sodium lighting along five roads involving supply, erection and wiring of 90 concrete columns with lanterns and accessories to class A standard. Engineer and Surveyor, Town Hall.

April 16.—Northern Ireland. Electrical installation in new nurses' home at N.I. Fever Hospital at Purdysburn. F. W. Parkinson and Partners, consulting engineers, 6 Murray St., Belfast. Deposit £3 3s.

April 16.—Port Talbot T.C. Electrical installation to about 500 houses in the borough. Borough Engineer and Surveyor, Municipal Buildings.

April 20.—Lancaster. Supply and installation in Riverside pumping station of two electrically driven centrifugal pumps to deal with 6,400 galls. of sewage per min. City Engineer, Town Hall. Deposit £2.

April 24.—Belfast. Supply and erection of drainage pumping equipment including 600 g.p.m. pumps, motors, pipes, valves, lighting tackle, etc., for Victoria power station. Merz and McLellan, consulting engineers, Carliol House, Newcastle-on-Tyne. Deposit £5 5s. (See Feb. 26 issue.)

April 24.—Manchester. Electrical installation in Openshaw College of Further Education in Whitworth St. City Architect, Town Hall. Deposit £1 1s. (See March 12 issue.)

April 24.—Oswestry R.D.C. Installation of electricity in 33 houses and part installation in 26 houses at Morda, Llanymynech and Ruyton-XI-Towns. C. H. W. Pugh, clerk, Council Offices, Castle View. Deposit £2 2s.

April 27.—Chatham (Kent). The Rochester, Chatham and Gillingham Sewerage Board require supply and installation of lighting and power cables, lamp standards, lighting fittings, junction boxes and ancillary equipment at Motney Hill Sewage Works, Rainham. Documents from consulting engineers, W. H. Radford and Son, Albion Chambers, Kent St., Nottingham. (See March 26 issue.)

Date not known.—West Hartlepool T.C. Supply of electrical materials for housing department. Also electrical installation in conversion of Tunstall Court into annexe for technical college. Borough Architect, A. G. Sinclair, Municipal Buildings.

No date stated.—Hendon (Yorks) T.C. Installation of electricity in 22 bungalows on Westlands estate. Roper Spencer and Hall, Architects, Scale Lane, Hull. Deposit £1 1s.

OVERSEAS

*Details of items marked * may be obtained on application to the Board of Trade, Horseguards Avenue, S.W.1, quoting reference.*

April 15.—Turkey. Supply of 15 transformers between 160 kVA and 600 kVA for Ankara Elektrik Havagazi ve Otobus Islebine Muessesi. B.o.T. (Ref.: CRE 10912/53).*

April 30.—South Africa. Supply of three centrifugal pumping units with squirrel cage induction type electric motors suitable for 380 V 3-phase 50 c/s a.c. supply, for City of Johannesburg. B.o.T. (Ref.: CRE 9527/53).*

May 1.—India. Supply of two 1000/1250 kVA station service transformers and three 100 kVA auxiliary transformers for Maithon Hydro Electric power station. Chief Electrical Engineer, Damodar Valley Corpn., Anderson House, Alipore, Calcutta 27.

May 14.—India. Supply and erection of 22 kV and 6·6 kV switchgear and accessories at Kussara, Worli, Kingsway and Mahim receiving stations for Bombay Electric Supply and Transport Undertaking. B.o.T. (Ref.: CRE 10217/53).*

May 14.—New Zealand. Post and Telegraph Dept. requires supply of 1700 switchboard lamps, B.P.O. No. 2 24V. Director General, (Stores Div.), G.P.O., Wellington. B.o.T. (Ref.: CRE 10975/53).*

May 22.—Australia. Supply of 72 outdoor-type distribution transformers and accessories to various specifications for Brisbane Dept. of Electricity. Specifications from Chief Engineer and Manager of Dept., Kelvin House, Adelaide St., Brisbane. 10s. 6d. per copy.

June 10.—New Zealand. State Hydro Electric Dept. requires supply of one spare runner wheel for an auxiliary turbine at Highbank power station. Dept. is at P.O. Box 8025, Wellington. B.o.T. (Ref.: CRE 9547/53).*

CONTRACTS PLACED

Coventry. Electrical work in new Hawes infants school, and in Stoke Aldermoor primary school, Thompson Electrical Co. Ltd., £1,049, and £1,157 resp.

Manchester. Electrical installation at Peel Hall primary school and Brooklands primary school, Hartley Electromotives Ltd.

Paddington B.C. Electrical work at Porchester Baths, Rashleigh Phipps and Co. Ltd., £1,105.

Peterborough T.C. Electrical installation in 116 houses on Dogsthorpe North estate, M. F. Hansen, £2,500.

Plymouth. Installation of 1953 illumination scheme, S. Western Electricity Board, £1,942.

Rotherham. Lighting installation at Canklow motive power depot for British Railways, C. A. Newton and Co. Ltd.

Sheffield T.C. Electrical installation in 630 houses on Hackenthorpe estate, Hobson and Scott, Ltd., £10,849.

Swansea T.C. Electrical installation in 225 houses on Cadle site, S. Wales Electricity Board, £5,598.

Tiverton T.C. Supply and erection of 34 street lighting columns on Cowleymoor site, S. Western Electricity Board, £1,510.

Torquay. Electrical installation in 111 houses and 36 flats on Sherwell Valley estate, Havil and Williams.

Wandsworth B.C. Supply of electric lamps for 12 months ending Mar. 31, 1954, Siemens Electric Lamps and Supplies Ltd.

West Hartlepool T.C. Floodlighting of Ward Jackson Park during Coronation, British Thomson-Houston Co., Ltd.

Your Queries — Answered

"Chalmit" well glass fittings, makers of? H.U.—Andrew Chalmers and Mitchell, 445/447 Hillington Rd., Glasgow S.W.2. (25349)

Three-pint electric kettle with the handle at the side, makers of? S.B.—We presume this refers to the 6-cup size tea kettle made by: Eltron (London) Ltd., Accrington Works, Strathmore Rd., Croydon. (25357)

"Colmore" irons, makers of? S.W.—Ega Electric, Ltd., Holyhead Rd., Wednesbury, Staffs. (25364)

Waste disposal sink unit, suppliers of? M.A.—Dishmaster (London) Ltd., 151 Gt. Portland St., W.1. (25376)

"Hayn" lawnmowers, makers of? L.E.—Nutt Eng. Co., Norwich St., Cambridge. (25383)

"Beethoven" irons, makers of? T.E.—Beethoven Electrical Equipment, Ltd., 89/91 Reddish Lane, Gorton, Manchester. (25391)

"Crown" carpet cleaning machine, makers of? T.E.—Smith and Paget, Ltd., Crown Works, Keighley. (25399)

"Grove" refrigerator, makers of? L.B.—Grove Eng. Co., Ltd., Butts Works, Barnoldswick, Nr. Colne. (25408)

The above are selected from questions we have answered this week. If you have a query, send it to us.

TRADE NOTES

New Branch. L.E.S. Distributors, Ltd., have opened a wholesale branch at 19 Stour Street, Canterbury.

Change of Address. As from April 1 the new address of the Leeds office of International Combustion Ltd. is National Employers' House, Quebec St., Leeds 1. Telephone number remains Leeds 33274.

Canadian Exhibition. For the Montreal Tool, Industrial Equipment and Plant Handling Materials Exhibition, which is to be held in Montreal from November 9 to 13, the British representatives are Douglas Storrie, Ltd., 19 Queen Street, Blackpool, who can provide all information to British manufacturers considering exhibiting.

Nigerian Tariff. In a revised Nigerian Customs Tariff, household refrigerators, dry batteries of not less than 20 V for radio sets, broadcast receivers, and electrical material used in connection with the generation, measurement, transformation, storage, transmission and distribution of electric power (except electroliers, lamps, lampshades) are exempted from import duties.

PRICES OF CABLE METALS AND OTHER MATERIALS
(at Tuesday night)

	£ s. d.	New York price
COPPER, electrolytic	280 0 0	—
LEAD, good soft pig (foreign)	91¼-91¼	108 0 0
" " "English" quality	92¼-93	
Tin (99·99·75%) (Cash)	932-933	—
" (3 months)	922-923	—
ALUMINIUM, commercial purity (del.)	166 0 0	—
ZINC	78¼-78¼	88 0 0
ARMOURING:		
Galv. Steel Wire (0.104 in.)	51 10 0	—
Mild Steel Tape (0.04 in.)	40 0 0	—

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, London W.C.2.

Auto Electricities (Norwich) Ltd., 6, Tombland, Norwich. Cap.: £2,500. Dirs.: N. E. Harvey, and D. F. H. Ray.

Auto-Shave Co. Ltd., 48 Warren St., W.1. Manufacturers of and dealers in electrical appliances, including electric shavers, etc. Cap.: £1,000. Dir.: R. G. Norton.

Beaumont (Television) Ltd., 2 St. Peter's St., Huddersfield. Cap.: £100. Electricians, television engineers, etc. Dirs.: F. H. Beaumont and W. E. Sykes.

Bonded Linings Ltd., 26 Barley Rd., Bridge Hill, Blackhill, Co. Durham. General, heating, ventilating, lighting, mechanical, electrical, radio, motor, marine, refrigerating, constructional and consulting engineers and contractors, etc. Cap.: £1,500. Dirs.: J. J. Robson, Mrs. M. Dixon and A. Askew.

Braine and Parris Ltd., 63, Seaside Rd., Eastbourne, Sussex. Engineers and general electrical installation contractors, etc. Cap.: £6,000. Dirs.: E. S. Parris and E. A. S. Parris.

British Relay Wireless and Television Ltd. To acquire and hold all or any part of issued share capitals of British Relay Wireless, Ltd.; British Wireless Exchange, Ltd.; Central Relay Wireless, Ltd.; and Link Sound and Vision Services, Ltd.; to acquire and grant concessions for and establish, provide, erect and maintain sound and television receiving and transmitting stations in the U.K. and elsewhere, etc. Cap.: £100. Dirs.: not named. Subs.: J. S. Hamilton and G. G. Williams, 18 Austin Friars, E.C.

E. A. Clark (Electrical) Ltd., Balfour House, Finsbury Pavement, E.C.2. Electrical and mechanical engineers and contractors, etc. Cap.: £100. Dirs.: E. A. Clark, H. G. Stumbles, Joan A. Clark and Marjory M. Stumbles.

Electric Panels Ltd., Norfolk House, Norfolk St., W.C.2. Electrical, mechanical, civil and heating engineers, etc. Cap.: £2. Dirs.: J. P. Hourston and J. J. Flood.

Electrical Power Drives Ltd., 20, Southampton Place, W.C.1. Cap.: £1,000. Dirs.: R. L. Dowler and Beatrice A. Dowler, and N. C. Stephens.

Fernbank Electrical Co. Ltd., Cap.: £100. Dirs.: to be appointed by subs. Subs.: Jean Herbert and Claire Moore, 128 Albany St., N.W.1.

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

Magstarlite Ltd. Meeting of creditors will be held at Berners Hotel, Berners St., W.1, on April 9 at 11 a.m., to nominate liquidator and committee of inspection.

Premier Electric Welding Co., (Mersey) Ltd. Resolution for voluntary winding-up passed at meeting on Mar. 18 when J. A. Ross, C.A., 1 Tithebarn St., Liverpool, was appointed liquidator.

Voluntary Liquidation

J. E. Swann and Co., Ltd., electrical engineers. At statutory meeting of creditors statement of affairs submitted showed liabilities amounting to £20,932. Assets estimated to realise £4,484 and after allowing £1,066 for preferential claims, there were net assets of £3,417, or deficiency as regarded creditors of £17,515. Issued share capital was £1,520 and, so far as contributories were concerned, there was total deficiency of £19,035. Resolutions passed confirming voluntary liquidation with N. W. Osborne, C.A., of Rushton Osborne and Co., 11-12 Finsbury Sq., E.C.2, as liquidator, with a committee of inspection.

BANKRUPTCY ACTS

Intended Dividends

Derby. Hector W. Sharp, electrical and radio engineer trading as "Willdays" at 178 Osmaston Rd., Derby. Last day for receiving proofs, April 13. Trustee is A. W. Hunter, Walter House, 418-422 Strand, London, W.C.2.

Salisbury. John S. Anderson, trading as Electronic Services at Nearavon, Salisbury St., Fordingbridge. April 12 is last day for receiving proofs. Trustee is A. H. Brown, The Square, Fordingbridge.

Dividends

Leominster. Claude D. Weatherhead, electrical engineer trading as Mortimer and Whitehead, of Burway Bridge Garage, Ludlow. First and final dividends of 6s. 7¾d. in £ payable at 126 Colmore Row, Birmingham 3, on April 14.

BUSINESS PROSPECTS

HOME

Aldershot. Tenders expected to be invited soon for erection of 132 flats on Denmark St. extension.

Alva T.C. Plans approved for 52 flats with maisonettes and 4 shops in second phase at redevelopment area.

Ashby-de-la-Zouch U.D.C. Approval given to new Ashby town hall estimated to cost between £1,500 and £2,000.

Basingstoke T.C. Plans approved for 50 dwellings on South Ham estate.

Batley (Yorks.) T.C. Plans approved for additional accommodation at Technical College.

Belfast. Construction of 51 flats on Kansas Ave. site. Housing Architect, 94 Chichester Street.

Bideford T.C. recommended to consider installation of electric lighting at Pannier Market.

Bradford. Erection of 120 houses in Thorpe Edge estate and 10 in Haworth Rd. City Engineer and Surveyor's Office, Town Hall.

Bristol. Construction of primary school at Brislington. J. Nelson Meredith, City Architect, Council House, College Green, Bristol.

Castleford (W. Riding) C.C. recommended to approve provision of fluorescent lighting with control panel in electrical laboratory at Castleford Whitwood Mining and Technical College.

Cheltenham R.D.C. Thirty houses, and probably further 20 flats to be built at Shurdington.

Cheshire. Site in Manchester Rd., Tytherington, acquired for new Tytherington secondary school.

Consett (Dur.) U.D.C. Forty houses to be built in Gloucester Road.

Croydon T.C. The 1954-55 building programme includes completion of Lanfranc secondary school (£157,000); completion of S. Croydon secondary school (£131,885); extension of John Newnham secondary school (£39,000); erection of St. Mary's R.C. secondary school (£95,040).

Dagenham. Bendas and Bendas, Ltd., are to erect clothing factory on L.C.C. Hainault estate.

Darlington. Plans approved for factory extensions in Dodsworth St., by Skorno Works Ltd.

Devon. Erection of county primary school on Buckland estate, Newton Abbot. Estimated cost, £41,010.

Droitwich T.C. Erection of 55 houses and 3 shops with 2 flats on various sites. Borough Engineer and Surveyor, Town Hall.

Ealing T.C. Approval sought for erection of 196 houses and 104 flats in third section of Northolt Park estate.

East Riding. Erection of an Institute of Agriculture at Bishop Burton. County Architect, County Hall, Beverley.

Essex. School building programme for 1954-55 includes Braintree North (£73,920); Melbourne Park site II junior (£49,280); Springfield junior (£49,280); and Chelmsford, Waterhouse Lane junior (£48,224).

Greenwich B.C. Layout plans approved for erection of 101 dwellings on Pont Rd. site. Richardson and Houfe, 31 Old Burlington St., W.1, are architects.

Hampshire. Approval given for erection of secondary school in South Leigh Rd., Warblington.

Huddersfield. New £86,000 infants' and junior school on Bradley estate included in this year's building programme.

Isle of Ely. Ely High school and Maple Grove primary school, March, included in 1953-54 building programme. Estimated costs £117,973 and £56,114 resp.

Keighley. Plans being prepared for erection of Baptist church on Bracken Bank estate to cost between £5,000 and £6,000.

Kendal T.C. Erection of 54 houses on Hall Garth estate. J. Barnfather, Borough Engineer and Surveyor, Municipal Offices, Lowther St.

Leamington Spa T.C. Erection of three blocks of 3-storey flats on Lillington estate. Rayner and Fedeski, architects, 28 The Parade.

Leek (Staffs.) R.D.C. Approval given to erection of 215 houses at Baddeley Green and others at Brown Edge.

Liverpool. Scheme submitted for £990,000 first phase of development of proposed hospital at Greaves Hall, Southport.

Luton T.C. Erection of Rambridge junior school. Borough Engineer's Office, Town Hall.

Londonderry. New county intermediate school to be built at Carthall, Coleraine. Education Offices, New Row, Coleraine.

Maidstone. Sussex Crumpets Ltd. planning new factory in Foster Street.

Middlesbrough. Work expected to begin in Nov. on Middle Beck No. 2 secondary school, and next Feb. on proposed Longlands College.

Morecambe and Heysham (Lancs) T.C. Revised plans submitted for erection of 204 dwellings on Branksome Drive estate.

Ormskirk U.D.C. Erection of 68 houses on Scott estate and 40 on Richmond estate, Burscough. E. J. Wright, surveyor, Council Offices, Burscough St., Ormskirk.

Penybont (Glam.) R.D.C. Construction of 26 houses at Cefn Cribbwr. Council's Surveyor, M. Matthews, Penybont Offices, Coity Road, Bridgend.

Redditch U.D.C. Erection of 56 houses on Batchley estate. E. Buckley, Engineer and Surveyor, Council House.

Southend T.C. It is proposed to build 351 flats on Shoebury estate.

Stockton-on-Tees T.C. Construction of junior school at Roseworth, Durham Rd. Borough Architect, 28 The Square.

Sunderland. Hall and Stafford, Sunniside Chambers, West Sunniside, are quantity surveyors for £50,000 health centre at Pennywell.

Tenterden (Kent) R.D.C. Approval given to erection of 40 houses at Biddenden, 30 at Appledore, and 28 on three other sites.

Wallsend. J. M. Angus, 21 Lovaine Place, Newcastle-on-Tyne, is architect for factory on Coast Road for Lignum Products, Ltd.

(Continued on page 662)

(Business Prospects contd)

Walthamstow. William Oliver's (Rubber) Ltd., will probably invite tenders early in the summer for rebuilding and extending factory in Blackhorse Lane.

Wigan T.C. Application to be made for sanction to borrow £132,450 for erection of 100 houses at Worsley Mesnes.

Windsor R.D.C. It is proposed to erect 220 houses at S. Ascot and 79 at Old Windsor during next 2½ years.

OVERSEAS

U.S.A. Source of supply for electrical control gear and traction motors for diesel electric locomotives required by Toledo, Peoria and Western Railroad, Peoria, Illinois. Usual requirements are for 2,000 h.p. diesel engines for driving generators which drive traction motor of about 500 h.p. Firms should write to Mr. J. Daily, the company's Superintendent of Motive Power.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Bi-ax, 714,841. Class 8. Electric shaving instruments and fittings. Philips Electrical Ltd., Century House, Shaftesbury Ave., W.C.2.

Contactrode. 714,712. Class 6. Welding rods. Philips Electrical Ltd., Century House, Shaftesbury Avenue, W.C.2.

Dixon. 683,287. Class 7. Floor cleaning machines etc. R. G. Dixon and Co. Ltd., Capitol Works, Empire Way, Wembley, Middx.

Filtavac. 714,115. Class 9. Vacuum cleaners, dust blowers and dust extracting apparatus. Filtavac, 64a, Church St., Kensington, W.8.

H. E. Ltd. in design, B713290. Class 9. Electrical, electronic and scientific instruments and apparatus. Harvey Electronics Ltd., 273, Farnborough Rd., Farnborough, Hants.

Interchief. B693,851. Class 9. Telephone instruments and apparatus for use in and being parts of internal communicating systems. E. Shipton and Co. Ltd., Ferndown Works, Northwood Hills, Middx.

Skypole. B713,553, and **Skytube.** B713,989. Class 9. Radio and television aerials. Belling and Lee Ltd., Cambridge Arterial Road, Enfield, Middx.

Varionic. B704,961. Class 7. Variable speed electric motors for power transmission. Nevelin Electric Co. Ltd., Purley Way, Croydon, Surrey.

Volstat. 714,364. Class 9. Electrical apparatus for regulating and changing voltage. Advance Components Ltd., Advance Works, Back Road, Shernhall St., E.17.

MEETINGS TO NOTE

THURSDAY, APRIL 2

BRITISH INSTN. OF RADIO ENGRS. (Scottish Section).—"Principle and Applications of Telescribe." C. A. Gilbert. Dept. of Natural Philosophy, The University, Edinburgh.

INCORP. PLANT ENGRS. (Peterborough).—"Industrial Fire Protection." W. H. Tuckey. Eastern Gas Board, Church St., 7.30 p.m.

TUESDAY, APRIL 7

INCORP. PLANT ENGRS. (Edinburgh).—"Elementary Industrial Electronics." J. H. Jones. Heriot-Watt College, 7 p.m.

A.S.E.E. (Nottingham Branch).—Ten-minute papers. Elect. Offices, Smithy Row, 7.30 p.m.

A.S.E.E. (W. London Branch).—"Architect and the Electrical Engineer." T. Dunwoody. Windsor Castle Hotel, 134 King St., Hammersmith, 7.30 p.m.

WEDNESDAY, APRIL 8

BRITISH INSTN. OF RADIO ENGRS. (London).—"Lens Aerials for Centimetric Wavelengths." Lt.-Col. J. P. A. Martindale. School of Hygiene, Keppel St., W.C.1, 6.30 p.m.

BRITISH INSTN. OF RADIO ENGRS. (N.E. Section).—Annual meeting. Demonstration of Stereoplant Reproduction. Neville Hall, Westgate Rd., Newcastle, 6 p.m.

INCORP. PLANT ENGRS. (E. Midlands).—"Peak Steam Demands and Thermal Storage." E. G. Ritchie. Welbeck Hotel, Nottingham, 7 p.m.

I.E.E. (N. Lancs Sub-centre).—"275 kV Developments on British Grid System." D. P. Sayers, J. S. Forrest and F. J. Lane. Elect. Board, Dawson St., Blackburn, 7 p.m.

I.E.E. (N. Scotland Sub-centre).—Annual meeting. Chairman's address by T. S. A. Primrose. Caledonian Hotel, Aberdeen, 7.30 p.m.

A.S.E.E. (Bradford Branch).—"Aluminium Sheathed Paper Cables." J. W. Robertshaw and J. Fall. Midland Hotel, 7.30 p.m.

THURSDAY APRIL 9

E.P.E.A. (Mersey Tech. Group).—"Power Station Lubrication." G. H. Clark. Elect. Showroom, Whitechapel, Liverpool, 7 p.m.

I.E.S. (Manchester Centre).—"Glass—Old Material in a New Light." P. M. Davidson. Elect. Offices, Town Hall Extension, 6 p.m.

I.E.S. (Nottingham Centre).—Presidential address by W. J. Wellwood Ferguson. E. Midlands Board, Smithy Row, 6 p.m.

BRITISH INSTN. OF RADIO ENGRS. (Scottish Section).—"Remote Control Devices and Servo Mechanisms." 39 Elmbank Crescent, Glasgow.

I.E.E. (London).—"Special Effects for TV Studio Productions." A. M. Spooner and T. Worswick. Savoy Place, W.C.2, 5.30 p.m.

I.E.E. (N. Lancs Sub-centre).—"275 kV Developments on British Grid System." Elect. Board, Finkle St., Kendal, 7 p.m.

I.E.E. (S. Midland Centre).—"Devising of Examination Questions." Prof. G. W. Carter. College of Technology, Birmingham, 7 p.m.

FRIDAY, APRIL 10

I.E.S. (Huddersfield Group).—Annual meeting at Elect. Showroom, Market St., 7.15 p.m.

A.S.E.E. (Crewe Branch).—"Welding." W. Barnett. Royal Hotel, Nantwich Rd., 7.30 p.m.

MONDAY APRIL 13

LEICESTER ELECTRICAL SOC. "Electrical Equipment for Collieries." P. H. Harvey. Elect. Offices, Charles St., 7 p.m.

I.E.S. (Sheffield Centre).—"Horticultural Applications of Light." A. E. Cantham. Annual meeting. University, Western Bank, 6.30 p.m.

I.E.E. (London Radio Section).—Discussion on "Relative Merits of Broad-Band Transmission by Beam, Cable and Waveguide." E. C. H. Organ. Savoy Place, W.C.2, 5.30 p.m.

I.E.E. (Mersey and N. Wales Centre).—Annual meeting at Liverpool Royal Instn., Colquith St., 6.30 p.m.

I.E.E. (N.E. Centre).—Annual meeting and Conversazione at Station Hotel, Newcastle, 6.15 p.m.

I.E.E. (S. Midland Supply and Utilisation Group).—"Characteristics and Control of Rectifier-Motor Variable-Speed Drives." P. Bingley. Imperial Hotel, Birmingham, 6 p.m.

EXHIBITION DIARY

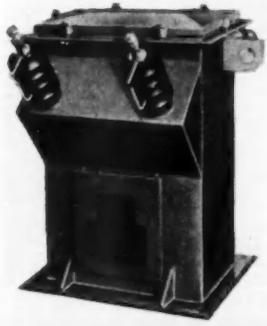
Physical Society. 37th Show at Imperial College, S. Kensington. Opens on April 13 and closes on April 17.

Radio Components. To be held at Grosvenor House, London, between April 14 and 16.

B.I.F. at Earls Court, Olympia and Castle Bromwich, opens on April 27 and closes on May 8.

HACKBRIDGE
TRANSFORMERS

One of two 3-phase 132/66/11kV. Hackbridge Transformers at a substation in Australia



HACKBRIDGE Transformers are backed by long and varied experience in the design and manufacture of transformers of every type, size and voltage — for supply, distribution and industrial applications. Also on-load voltage regulating equipment, reactors, arc-suppression coils and high-grade instrument transformers.

HACKBRIDGE AND HEWITTIC ELECTRIC CO., LIMITED
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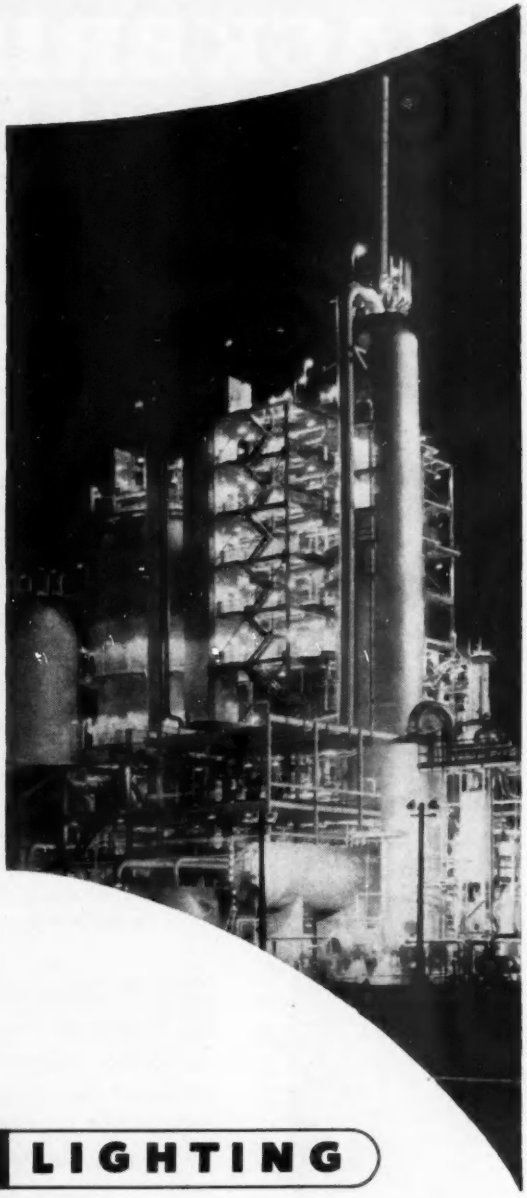

More than 3000 Metrovick Lighting Units are in service at the "Esso" Refinery Fawley, Southampton

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Member of the AEI group of companies

METROPOLITAN-VICKERS ELECTRICAL CO. LTD., ST. PAUL'S CORNER, 1-3 ST. PAUL'S CHURCHYARD, LONDON, E.C.4
S/A 209

CLASSIFIED ADVERTISEMENTS

OFFICIAL TENDERS AND APPOINTMENTS

WORK WANTED WANTED · FOR SALE

Those wishing to advertise in these pages should send the text to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London W.C.2, before 10 a.m. on TUESDAY of week of issue. Official Displayed Advertisements are charged at 42s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted will be published four times for twice the single insertion rate. Fee for Box No. and postage on replies is 2s.

TENDERS INVITED

COUNTY BOROUGH OF SWANSEA

Penlan Multilateral School, Penlan, Swansea

TENDERS FOR ELECTRICAL INSTALLATION

FIRMS wishing to tender for the Electrical Installation at Penlan Multilateral School now in course of erection at Penlan, Swansea, are invited to submit their applications to the Borough Architect, The Guildhall, Swansea, on or before Saturday, April 11, 1953.

Plans, Specifications and Conditions of Contract can be obtained on application and deposit of £2, provided the applicant gives satisfactory evidence of having previously carried out work of a similar character.

The deposit will be refunded after delivery of a bona fide Tender (which is not subsequently withdrawn) and the return of all documents.

No guarantee is given that the lowest or any other Tender will be accepted

T. B. BOWEN,
Town Clerk.

The Guildhall,
Swansea.
March 19, 1953. (D 267)

CITY OF BELFAST

Electricity Department

DRAINAGE PUMPING EQUIPMENT

NOTICE is hereby given that the latest time for the receipt of Tenders for Drainage Pumping Equipment at Victoria Power Station (Form of Tender No. N.1349) has been extended from 4 p.m. on April 10, 1953, until 4 p.m. on Friday, April 24, 1953.

JOHN DUNLOP,
Town Clerk.

City Hall, Belfast.
March 20, 1953. (D 318)

APPOINTMENTS VACANT

Employment of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

BRITISH ELECTRICITY AUTHORITY

Eastern Division

APPLICATIONS are invited for the following appointments in the Generation (Construction) Department at Divisional Headquarters:—

DRAUGHTSMEN (MECHANICAL)

Salary Grades 4 to 6, £456 to £619 per annum.

The commencing salary (which includes London Weighting) will depend upon experience and qualifications but will be within the above range.

Applicants should preferably have experience in generating station plant layout and design of pipework, coal, ash and dust handling systems.

Applications stating age, qualifications and experience should be sent to the Divisional Controller, British Electricity Authority, Eastern Division, Northmet House, Southgate, N.14, by April 18, 1953.

W. N. C. CLINCH,
Controller.
(D 319)

NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF JUNIOR ENGINEERS (TESTING ASSISTANTS)

Oldham

APPLICANTS should have had experience of testing work associated with industrial meters, instruments or protective equipment. Possession of the Higher National Certificate will be an advantage. Experience in manufacturers' works will be considered an additional recommendation.

Salary Scale: £390 to £545 p.a., Grade "K.19/15," N.J.B. conditions.

Applications to Manager, No. 3 Sub-Area, The North Western Electricity Board, Union Street, Oldham, by April 11, 1953.

APPOINTMENT OF JUNIOR ENGINEER
Consumers' Engineer's Department, Blackburn

Applicants should be experienced in the control and supervision of contract wiring, preparation of specifications, and the installation, repair and maintenance of appliances. Graduate Membership of the Institution of Electrical Engineers or possession of the Higher National Certificate in Electrical Engineering will be an advantage.

Salary Scale: £390 to £545 p.a. Grade "J.18/14," N.J.B. conditions.

Applications to Manager, No. 5 Sub-Area, The North Western Electricity Board, Jubilee Street, Elackburn, by April 11, 1953. (D 320)

BRITISH ELECTRICITY AUTHORITY

London Division

APPLICATIONS are invited for the following superannuable posts. Salary, including London allowance, and conditions of service in accordance with N.J.B. Agreement, Schedule "A."

ASSISTANT SHIFT CHARGE ENGINEER
Blackwall Point Generating Station

Qualifications: Sound engineering and technical training with practical experience in the operation of a modern generating station, preferably with p.f. firing equipment. Salary, Class "F," Grade 9, £637 7s. p.a.

ASSISTANT SHIFT CHARGE ENGINEER
Deptford East Generating Station

Qualifications: Sound engineering and technical training with practical experience in operation of a large modern generating station. Salary, Class "H," Grade 9, £714 p.a.

Applications may be made on form obtainable from Divisional Secretary, B.E.A., London Division, Generation House, Great Portland Street, W.1, and be received not later than 14 days of the appearance of this advertisement. (D 308)

BRITISH ELECTRICITY AUTHORITY

North Western Division

APPLICATIONS are invited for the following positions:

Vacancy No. 41/53—DEPUTY POWER STATION SUPERINTENDENT, Carrington Power Station. Good technical education and wide practical experience of power plant essential. Corporate member of recognised engineering institution preferred. Salary £1 035 to £1,081 (H.3).

Vacancy No. 42/53—MAINTENANCE ENGINEER (ELECTRICAL), Carrington Power Station. Qualifications, good technical education, corporate membership of I.E.E. and wide experience of power plant electrical equipment. Salary £833 to £866 (H.6).

Vacancy No. 47/53—ASSISTANT SHIFT CHARGE ENGINEER, Stuart Street Power Station, Manchester 11. Salary £680 to £706 (H.9).

Vacancy No. 48/53—ASSISTANT SHIFT CHARGE ENGINEER, Whitebirk Power Station, Blackburn. Salary £641 to £677 (G.9).

Apply to Establishments Officer, British Electricity House, 625 Wilmslow Road, Manchester 20, before April 11. Quote vacancy number. (D 292)

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ASSISTANT (N.J.C.)
Eastbourne District

SALARY £460 by £20 to £520 p.a. under N.J.C. Grade 2. Superannuable. Applicants should have experience in negotiating supplies, load development, consumers services, tariffs, sales of electrical appliances and organisation of exhibitions.

Applications on forms obtainable from District Managers or senior officers, giving two referees, must reach J. E. Winborne, District Manager, SEEBoard, Electric House, Grove Road, Eastbourne, by April 15, 1953.

JOINTERS (E.H.T.)

Wages 3s. 6½d. per hour for a 44-hour, 5-day week under N.J.I.C. Agreement.

Thanet District (two vacancies)

Applications, giving two referees, to H. J. C. Carte, M.B.E., A.I.E.E., Thanet District Manager, SEEBoard, St. Peter's, Broadstairs, Kent.

Crawley District

Applications, giving two referees, to F. A. Avery, A.I.E.E., Crawley Manager, SEEBoard, 55 High Street, Crawley, Sussex.

Applications should be received by April 15, 1953.

A. L. BURNELL,
Secretary.

March 25, 1953. (D 307)

YORKSHIRE ELECTRICITY BOARD

APPLICATIONS are invited for the following appointment:—

No. 5 (Wakefield) Sub-Area

Barnsley District

GENERAL ASSISTANT DISTRICT ENGINEER

Applicants should preferably be Graduate Members of the Institution of Electrical Engineers and have experience in the construction, operation and maintenance of overhead and underground distribution systems.

Candidates should be prepared to reside in the district and undertake standby duties.

Salary: N.J.B. Class "F," Grade 11, £548 to £565 per annum.

Applications giving full details of age, qualifications, and experience should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a Denby Dale Road, Wakefield, not later than April 16, 1953. (D 322)

BRITISH ELECTRICITY AUTHORITY

South Eastern Division

MAINTENANCE ENGINEER (Mechanical) at Kingston "B" Power Station. Applicants should preferably possess B.Sc. degree or equivalent or be Corporate Members of the Institution of Mechanical Engineers, and must have had experience in the control of labour. Extensive experience in the maintenance of high-pressure turbine and boiler plant and power station auxiliaries essential. N.J.B. conditions of service. Class "G," Grade 6, £826 7s. p.a., including London allowance. Applications, giving details of education, present position, experience, etc., should be sent to the Station Superintendent, Kingston "B" Power Station, Downhall Road, Kingston-upon-Thames, Surrey, to arrive by April 11. (D 311)

BRITISH ELECTRICITY AUTHORITY

North Western Division

APPLICATIONS are invited for the following positions:

Vacancy No. 51/53—STATION SHIFT CONTROL ENGINEER, Barton Generating Station, Urmston, near Manchester. Salary £641 to £667 (NJB. H.10).

Vacancy No. 52/53—STATION SHIFT CONTROL ENGINEER, Stockport Generating Station. Salary £577 to £598 (NJB. F.10).

Vacancy No. 53/53—STATION SHIFT CONTROL ENGINEER, Westwood Generating Station, Wigan. Salary £608 to £630 (NJB. G.10).

Vacancy No. 54/53—SHIFT CHARGE ENGINEER, Greenhill Generating Station, near Oldham. Salary £649 to £681 (NJB. E.7).

Apply to Establishments Officer, British Electricity House, 825 Wilmslow Road, Manchester 20, before April 11. Quote vacancy number. (D 305)

BRITISH ELECTRICITY AUTHORITY

South Wales Division

Vacancy No. 23/53

APPLICATIONS invited for superannuable appointment of STATION SHIFT CONTROL ENGINEERS, Carmarthen Bay Power Station. N.J.B. K. 10 (£719-£750 p.a.).

H.N.C. and experience in Control Room of modern power station required.

Application forms obtainable from Divisional Secretary, British Electricity Authority, South Wales Division, Twyn-y-Fedwen Road, Gabalfa, Cardiff, should be returned by April 13, 1953. (D 310)

GOLD COAST GOVERNMENT

VACANCIES FOR ELECTRICAL ENGINEERS
Electricity Department

APPLICATIONS are invited for vacancies in the post of Electrical Engineer in the Electricity Department. Duties: Will include the complete investigation and planning of new electricity undertakings and the expansion of existing undertakings; the preparation of schedules and the supervision of contracts.

Qualifications: Candidates should be Corporate Members of the Institution of Electrical Engineers or possess equivalent qualifications. They should have been regularly trained as electrical engineers and have had a wide subsequent experience with an electricity supply authority in design and construction of e.h.t. and l.t. underground and overhead distribution systems. A knowledge of compression ignition engines would be an advantage.

Terms of service: The appointments will be on contract/gratuity terms for one tour of 18-24 months with a possible extension to two tours. Salary will be in the range £810-£2,020 per annum (consolidated) according to age, qualifications and experience. A gratuity at the rate of £37 10s. (or £25, if salary less than £1,000) for each completed three months of satisfactory service will be payable on final termination of the contract.

Free passages on first appointment and on leave will be provided for the officer and his wife once each way during each tour of service. Officers will normally be required to travel by air. Free air passages will also be provided for a maximum of three children under 13 years of age.

Vacation leave with pay: Seven days for each month of service. Free medical and dental attention provided for officer and family. Furnished quarters available at low rental. Income tax at low local rates. Kit allowance on first appointment, £30-£60, according to salary. Contributions to the Widows' and Orphans' Pension Fund are at present compulsory.

These posts are "Development Posts" for implementation of specific projects under the Gold Coast Development Plan and are strictly temporary. On termination of the contract, the officer would not be eligible for transfer to any other Government appointment but would be able to apply for appointment to another post, if desired.

Intending candidates should apply to the Gold Coast Commissioner, Melbourne House, Aldwych, London W.C.2, for application form. (D 309)

NORTH EASTERN ELECTRICITY BOARD

Wear Sub-Area

APPLICATIONS are invited for the appointment of SECOND ASSISTANT ENGINEER, Wear Sub-Area Headquarters Staff, with location at Chester-le-Street District Headquarters, Philadelphia.

Considerable experience with construction and erection of h.v. overhead lines and overhead l.v. networks is required, together with ability to take charge of construction gangs in the field.

Salary, Schedule "A," Class "L," Grade 7, £926 to £966. N.J.B. conditions of service.

Applications, stating age, qualifications and experience, should be forwarded to the Secretary (Establishments), the North Eastern Electricity Board, Carliol House, Newcastle-upon-Tyne 1, within ten days of the appearance of this advertisement. (D 291)

BRITISH ELECTRICITY AUTHORITY

Midlands Division

SHIFT CHARGE ENGINEERS required at Meaford Generating Station. N.J.B. service conditions, superannuable appointments, salaries within Schedule "A," Grade "G.7," commencing at £729 per annum.

Higher National Certificate in electrical and mechanical engineering required, and sound technical training and practical experience in the control and operation of steam generating plant and main switchgear, or mechanical and electrical experience in a manufacturer's works.

Application forms available from Establishments Officer, 53 Wake Green Road, Moseley, Birmingham 13, and should be returned by April 16, 1953. (D 321)

BRITISH ELECTRICITY AUTHORITY

South Wales Division

Vacancy No. 26/53

APPLICATIONS are invited for superannuable N.J.B. appointment of GENERAL ASSISTANT ENGINEER in the Transmission Department of this Headquarters. Salary "AX/CX 8" (£501 to £675 p.a.).

Applicants should hold H.N.C. (Elect.) or its equivalent, and have experience in the maintenance of h.v. substations and overhead lines; a knowledge of 132 kV equipment an advantage.

Application forms obtainable from Divisional Secretary, British Electricity Authority, South Wales Division, Twyn-y-Fedwen Road, Gabalfa, Cardiff, should be returned by April 17, 1953. (D 331)

BRITISH ELECTRICITY AUTHORITY

South Eastern Division

APPLICATIONS are invited for the following positions at Littlebrook Power Station.

(a) ASSISTANT ENGINEERS (EFFICIENCY). The successful applicant will be responsible to the Operation and Efficiency Engineer for the efficiency and testing of a section of the plant. Preference will be given to those possessing Higher National Certificate or equivalent and who have had previous experience in the operation and/or testing of high-pressure plant.

(b) JUNIOR ENGINEERS (EFFICIENCY). Required to assist the Assistant Engineers (Efficiency) and preference will be given to those possessing Ordinary National Certificate and who have had experience of power station plant.

N.J.B. conditions and salary as follows: (a) Class "M," Grade 11, £793 16s. p.a. (including London Allowance); (b) Class "M," Grades 21/17, commencing at £415 p.a. to a maximum of £574 7s. p.a. (including London Allowance).

Applications, giving details of education, present position, experience, etc., should be received by the Station Superintendent, Littlebrook Power Station, nr. Dartford, Kent, by April 20, 1953. (D 332)

BRITISH ELECTRICITY AUTHORITY

East Midlands Division

APPLICATIONS are invited for the following positions within the Division:—

CIVIL ENGINEERING DRAUGHTSMEN

Construction Department, North Wilford
Vacancy No. 22/53

Candidates should have experience in design and detail of reinforced concrete structures, piled and slab foundations for heavy plant, culverts, cable subways, etc., for general building construction drainage and sanitation schemes, associated with offices and administrative buildings.

The salary will be in accordance with Grade 5 (£567 to £671 per annum) or Grade 6 (£433 to £567 per annum) of Schedule "D" of the National Joint Board Agreement.

POWER STATION SUPERINTENDENT

Chesterfield Generating Station. Vacancy No. 40/53

Candidates should have experience in the operation, maintenance and administration of an electricity generating station and be the possessor of appropriate technical qualifications.

The terms and conditions of service will be those approved by the National Joint Board and the salary paid will be in accordance with Class "B," Grade 1 (£876 to £920 per annum) of the National Joint Board Agreement.

Closing date for this appointment will be April 9, 1953.

JUNIOR ENGINEERS

Staythorpe Generating Station. Vacancy No. 41/53

Junior Engineers are required at Staythorpe Generating Station, where suitable young engineers will be given opportunity to obtain operating and maintenance experience in the various sections of this large generating station operating at 900°/900 lb sq in. steam conditions.

The salary will be within Class "J," Grades 17-14 (Range £408 to £545 per annum) of the National Joint Board Schedule.

Preference will be given to candidates who hold the Higher National Certificate, or who are at present pursuing a course of study with the object of obtaining this or a similar qualification.

Closing date for this appointment will be April 13, 1953.

DRAUGHTSMAN

Transmission Department, Divisional Headquarters, Nottingham. Vacancy No. 42/53

Candidates should preferably have had experience in one or more of the following: Design and construction of high-voltage sub-stations or overhead transmission lines and underground cable systems; civil engineering, electrical engineering, including lay-outs and diagrams for h.v. transformers and switchgear.

Salary and conditions of service will be in accordance with the National Joint Board Agreement, Grade 6 of Schedule "D" (£433 to £567 per annum) according to qualifications and experience.

Closing date for this appointment will be April 13, 1953.

The above appointments will be pensionable within the provisions of the British Electricity Authority and Area Boards' Superannuation Scheme.

Applications should be submitted on the official form which may be obtained from the Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham, and should be returned to the undersigned by the dates stated. Please quote vacancy number.

L. F. JEFFREY,
Divisional Controller.
(D 334)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

ENGINEERING DRAUGHTSMAN required at Board Headquarters, Electricity House, Love Lane, Liverpool 3, at a salary within the range £433 to £567 per annum (N.J.B. D/6).

Applicants should preferably have experience in the general design and layout of indoor and outdoor substations up to 33 kV, cable layout, diagrams of connections, etc., and should have reached the Ordinary National Certificate standard.

The appointment is superannuable and subject to medical examination.

Application forms obtainable from the Establishments Officer at the above address. Quote ref. 132A. Closing date April 20, 1953. (D 344)

BRITISH ELECTRICITY AUTHORITY

Yorkshire Division

REQUIRE JUNIOR ASSISTANT CHEMIST at Kirkstall Power Station, Leeds.

Applicants should hold the Higher National Certificate in Chemistry or its equivalent, and have had previous laboratory experience, preferably associated with the analysis of coal, water and oil.

Salary £390 to £516 per annum, Class "H," Grade 17 to 14, N.J.B. Agreement, Superannuation Scheme.

Application forms obtainable from Divisional Secretary (Establishments), British Electricity Authority, St. Mary's Road, Leeds 7, to be returned within 10 days of the appearance of this advertisement.

G. A. VOWLES,
Divisional Controller.
(D 333)

A CABLE COMPANY, London area, require (1) SENIOR CHEMIST with University degree or equivalent qualifications and experience in the design of rubber and P.V.C. compounds and the manufacture of a wide range of rubber and plastic cables. Salary up to £1,000 according to qualifications and experience. (2) JUNIOR CHEMIST with University degree, or other qualifications and experience in the cable, rubber or plastic industries Salary up to £600.—Apply Box No. 2527, Electrical Times (D 261)

AGENTS required for "off-peak" thermal storage space heating. Technical knowledge and sound connection with contractors and Electricity Boards essential. Three areas—Midlands, West, S. Wales.—Reply, Thermodare (Great Britain) Ltd., 36 Victoria Street, London, S.W.1. (D 340)

AN EXPERIENCED CHARGE ENGINEER (shift duties), age over 30 years, is now required for permanent position in an industrial steam power plant in London area. Commencing salary £800 to £900 according to qualifications. Post is pensionable.—Reply Box No. 2521, Electrical Times, quoting reference SCE/2. (D 249)

APPLICATIONS are invited for the post of ASSISTANT to the works Engineer. Must have served a recognised apprenticeship. Higher National Certificate or equivalent essential. Duties chiefly mechanical maintenance. Should be capable of deputising for the Works Engineer in co-ordinating mechanical, electrical and building maintenance work.—Apply, Personnel Director, Ferguson Bros. Ltd., Holme Head Works, Carlisle. (D 277)

ASSISTANT CORROSION ENGINEER required by Kuwait Oil Company for service in Kuwait. Should possess a degree in electrical or chemical engineering or metallurgy, but Higher National Certificate in any of these subjects plus a full recognised engineering apprenticeship would be acceptable. Experience in corrosion engineering an advantage but not essential as successful candidate will undergo some training in the U.K. Age 22-30. Overseas salary starting £790 p.a. clear, plus generous allowances, pension scheme and kit allowance. —Write for application form, giving personal details and quoting K.1676 to Box No. W/17, c/o 191, Gresham House, E.C.2. (D 223)

ASSISTANT ELECTRICAL ENGINEER required, age 21-25 years. Applicants must have served a works apprenticeship, H.N.C. standard preferred. Experience required in the preparation of specifications, estimating of motors, control gear and allied equipment, and capable of acting in a technical advisory capacity.—Applications must be made in writing to the Sturtevant Engineering Co. Ltd., Southern House, Cannon Street, London E.C.4, and marked for the attention of Reference G.19, stating full particulars of education, age, experience and salary required. (D 263)

BOX No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London W.C.2

JOHNSON & PHILLIPS, LIMITED
CHARLTON, S.E.7

MANAGER OF SWITCHGEAR DEPARTMENT

APPLICATIONS are invited from well qualified Engineers with considerable experience in the switchgear industry for the appointment of Manager, Switchgear Department.

The successful applicant will be required to take full responsibility for design, development, production and the commercial conduct of this increasingly important section of the Company's activities. He will also be required to exercise overall technical control of the activities of the Company's switchgear factories overseas.

Applications, which will be treated in strict confidence, should be addressed to:—

The Managing Director,
JOHNSON & PHILLIPS, LIMITED,
CHARLTON, LONDON, S.E.7. (D 299p)

A FOREMAN ARMATURE-WINDER with repair shop experience of a.c. and d.c. also f.h.p., for small but expanding firm. Excellent opportunity for man with initiative, not over 40.—Box No. 2529, Electrical Times. (D 262)

APPLICATIONS are invited for the following posts in the "A" Steam Power Station of the Karachi Electric Supply Corporation, Pakistan, the Managing Agency of which is owned by the Government of Pakistan. The station is equipped with five turbo-alternator sets, including three geared 5,000 kW, 400 p.s.i.g., 11 kV sets. All boilers are B. and W. oil-fired (types FH, WIF and CTM). Each appointment will be on agreement for a period of three years, subject to three months' notice on either side. Basic salary (at present £1 equals Rs.9) will normally be within the scale mentioned below, according to qualifications and experience, but a higher salary may be granted in exceptional cases. Dearness allowance (as per the Corporation's rules) will be additional. First class passages will be paid between the U.K. and Karachi for the officer, his wife and up to three children at commencement and termination of agreement period. Applicants must state age, qualifications, full particulars of experience, minimum salary required and names of three independent referees.

(i) STEAM POWER STATION SUPERINTENDENT. Applicants must have had extensive experience in the installation, operation, maintenance and economics of steam power stations. Duties will be more operational than administrative. Basic monthly salary ranges from Rs.1,302 to Rs.1,952. Present monthly dearness allowance is Rs.225.

(ii) TURBINE HOUSE HEAD FOREMAN. Applicants must have had extensive experience in the installation, operation and maintenance of steam turbines, and will be required to train Pakistani personnel. Basic monthly salary ranges from Rs.752 to Rs.1,282. Present monthly dearness allowance is Rs.171 to Rs.225.

(iii) BOILER HOUSE HEAD FOREMAN. Applicants must have had extensive experience in the installation, operation and maintenance of oil-fired boilers of the types installed (or similar), and will be required to train Pakistani personnel. Basic salary and dearness allowance as for Turbine House Head Foreman.

Box No. 2545, Electrical Times. (D 323)

ASSISTANT ENGINEERS required by prominent company supplying power station steam generating plant. Permanent progressive post based on London but entailing extensive travelling to sites throughout country for testing and investigations. Applicants must have sound education in mechanical engineering. Previous steam experience an advantage. Salary according to age and experience.—Box No. 2537, Electrical Times. (D 293)

BRITISH ELECTRICITY AUTHORITY—Production, Inspection and Test Sub-Branch, require a THIRD ASSISTANT ENGINEER (ELECTRICAL) in the Manchester Regional Office. Candidates should be Graduate Members of the I.E.E., or hold equivalent qualifications. Recent first-hand experience of Production methods, test and inspection work in manufacturers' works in connection with plant and equipment for modern power stations is essential, and some experience of constructional and plant erection work at power stations and attendance at Site Progress Meetings would be an advantage. Salary N.J.B. Grade 4, £717—£934.

Applications, stating age, qualifications, experience and salary to: D. Moffat, Director of Establishments, Winsley Street, London, W.1, by April 18, 1963. Quote reference AE/354. (D 313)

CHEMICAL ENGINEER required to plan and superintend the chemical processes associated with the development and production of a synthetic crystalline product. (Harlow area.) Must possess degree in physics and chemistry and have had two or three years' experience in chemical engineering. House arranged if required.—Write, Box N.3930, A.K. Advg., 212a Shaftesbury Avenue, London W.C.2. (D 294)

CONTRACT ENGINEERS required for Switchgear Tenders and Contracts, single men preferred.—Applications giving age, training, subsequent experience and salary required to: Personnel Manager, South Wales Switchgear, Ltd., Blackwood, Mon. (D 312)

DRAUGHTSMEN required for low tension small switch and fuse gear.—Write, giving age, details of experience and salary expected, to the Personnel Officer, W. T. Henley's Telegraph Works Co., Ltd., Gravesend, Kent. (D 193)

ELECTRICAL DRAUGHTSMAN required for large paper mill by Bowater's Thames Paper Mills, Ltd., at Northfleet, Gravesend, Kent. Must be experienced in layout of power installations, wiring diagrams and switchgear. Some mechanical experience an advantage.—Please state age, experience and qualifications. (D 150)

ELECTRICAL DRAUGHTSMAN required, preferably with some knowledge of resistances.—Applications, in writing, giving full particulars, to E. A. and J. Y. Walsh Ltd., Barton Road Works, Worsley, Manchester. (D 337)

ELECTRICAL ENGINEER. Old-established medium/heavy engineering company require qualified Electrical Engineer capable of drawing up electrical specifications for company's products, including wiring diagrams and supervising wiremen on the shop floor.—Box No. 2511, Electrical Times. (D 240)

ELECTRICAL ENGINEER required to take charge of department dealing with engineering and technical liaison of a high precision frequency control product. (Harlow area.) Knowledge of and experience in electronic and telecommunication work essential. Must possess Honours General or Electrical Engineering Degree. House can be arranged if required.—Write, Box N.3927, A.K. Advg., 212a Shaftesbury Avenue, London W.C.2. (D 295)

ELECTRICAL MECHANICS are required for interesting operation and service work in a large industrial high-frequency power plant. Successful candidates should preferably possess some technical training and experience of control circuit maintenance. Experience of radar-transmitter equipment would also be an advantage. An initial period of training will be given for the work, which is situated in congenial surroundings. High rates are payable.—Apply Box No. 2547, Electrical Times. (D 324)

ELECTRONIC ENGINEER required for Turbine Laboratory. Should possess a degree in Electrical Engineering and previous laboratory experience in Physics, Electrical Engineering or Instrument Technology would be an advantage.—Send details of qualifications, experience and salary required to: The Personnel Officer, Sir George Godfrey and Partners, Ltd., Hampton Road West, Hanworth, Middlesex. (D 314)

ENGINEERS with initiative required for team making detailed study and preparing scheme for planned development of large integrated works producing pig iron and chemical products. Honours University Degree desirable and/or membership of professional institutions. Wide practical experience of works' layout and techniques essential. Some administrative experience desirable. Location London, but work will involve travelling. Salaries according to experience, age and qualifications.

ELECTRICAL/MECHANICAL ENGINEERS, with special experience of calculations on power generation and distribution for the modernisation of a complex works' power system services, etc.

Apply immediately, giving full details of experience, age, qualifications, and salary required, to Box No. 2533, Electrical Times. (D 279)

EXPERIENCED TECHNICAL SALES and CONTRACTS ENGINEER required as direct assistant to Sales Manager. Situation calls for knowledge of rotating electrical equipment, handling of correspondence and office procedure. Age 30 to 40 years. Salary in accordance with experience and qualifications. Successful applicant will have opportunity of joining the company's pension scheme for senior staff.—Apply, giving full details, to Personnel Manager, Small Electric Motors, Ltd., Eagle Works, Churchfields Road, Beckenham, Kent. (D 345)

Employment of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59 unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

FLEXIBLE MOULDED RUBBER ELECTRICAL CONNECTORS. A large electrical firm, N. London, requires a TECHNICIAN to work on all aspects of the design and manufacture of these products. Applicants who have not had experience in this particular field will be considered if they have worked on the design and mass production of small moulded rubber products. The resources of a large cable and rubber works are available. The position offers excellent prospects to a person who is able to develop this new line of manufacture in a large organization.—Reply to Box No. 2549, Electrical Times. (D 325)

INSTRUMENT MAKERS AND PRECISION FITTERS urgently required by Ministry of Supply for services as Research and Experimental Mechanics at Harwell. Applicants must have served a recognised apprenticeship or its equivalent and have had at least 5 years subsequent experience as a craftsman with a firm of scientific instrument makers, or with a firm making or maintaining electronic, electrical, pneumatic, horological, or optical instrument mechanisms. Rates of pay for 44 hour, 5-day week: 165/4 on entry with assessment for merit pay. Merit pay agreed after first assessment can be applied from date of entry. Possibility of advancement to 189/4.

Apply, giving details of apprenticeship, training (including Forces' training), qualifications and experience to Director, A.E.R.E., Harwell, Didcot, Berks, marked "For attention of Senior Labour Manager." (D 326)

MACHINERY MERCHANTS require ENGINEER to take charge of department handling purchase and sale of used motors. The successful applicant must be regularly trained and with specialist knowledge of the trade, able to conduct all aspects of this work, including organisation of a large stock and execution of orders from start to finish. Replies should give fullest particulars of training and career to date and will be held in strictest confidence. Tenable London.—Write, Box No. 2543, Electrical Times. (D 304)

MANUFACTURER requires REPRESENTATIVES, all areas. Must have connections with electrical wholesalers. To carry as extra line wood switch blocks.—Box No. 2553, Electrical Times. (D 342)

NATIONAL COAL BOARD invite applications for a superannuable appointment as CONTROL AND SWITCHGEAR ENGINEER in the Mechanical and Electrical Engineering Branch at London Headquarters.

Although primarily concerned with control and switchgear the successful candidate will be expected to do other general electrical work. Preference will be given to applicants with some or all of the following qualifications and experience: eligibility for Associate Membership of the Institution of Electrical Engineers; experience at a manufacturers' works on design, manufacture and application of all types of mining electrical apparatus; experience of electrical engineering at a coal mine.

The salary will be within a range of £1,000 to £1,250 per annum, according to qualifications and experience.

Apply in writing, giving full particulars (in chronological order) of age, education, qualifications and experience (with dates) to: National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, marking envelope TT/613. Original testimonials should NOT be forwarded. Closing date, April 30, 1953. (D 315)

QUALITY CONTROL SUPERVISOR for manufacture of paper insulated power cables up to high voltages. At least National Certificate standard with knowledge of power cable materials. Previous manufacturing experience an advantage. Age 22 to 30 years. Good salary with prospects.—Apply in writing to Staff Officer, British Insulated Callender's Cables, Ltd., Belvedere, Kent. (D 296)

REPRESENTATIVES for selected territories required by well-known manufacturers of cables, cords and harnesses. Applicants must have personal connection with manufacturers of domestic and industrial appliances, telecommunications apparatus, etc.—Write full details, which will be treated in strict confidence, to Box No. 2513, Electrical Times. (D 245)

REPRESENTATIVE required to cover the South West of England and South Wales. This is an interesting post offering scope for enterprise. Pension scheme. Applicants should be car owners and have good contacts throughout the area.—Apply in confidence to the Sales Manager, M.K. Electric Ltd., Wakefield Street, London, N.18. (D 341)

SALES MANAGER required by prominent manufacturing company in the electrical industry. The position involves control of sales force in London and provinces and requires considerable knowledge of sales techniques and experience in selling in a highly competitive field.—Applications, giving full details of past career, should be sent in confidence to Box A.561, c/o Central News, 17, Moorgate, London, E.C.2. (D 316)

SALES REPRESENTATIVES of proved ability required by switchgear manufacturers for Glasgow, Leeds and Cheshire. Car owners preferred.—State age, experience and all details to Box No. 2509, Electrical Times. (D 239)

CABLE INSTALLATION STAFF FOR SERVICE ABROAD

A LARGE Cable Manufacturing and Contracting Company requires the following staff for permanent service in South Africa and Australia:—

(a) Contract Engineer to take full charge of cable installation contracts.

(b) Assistant Contract Engineers for supervising cable installation contracts.

(c) Jointing Engineers to take charge of super-tension cable jointing and to train jointers.

(d) Super-tension cable Jointers.

Employment will be mainly on contracts for the laying and jointing of super-tension cables of all types. Suitable applicants would undergo a period of training and probation in the United Kingdom, and confirmation of appointments abroad would follow the satisfactory completion of this period. The situations would be permanent and salary would be according to qualifications and experience.

Previous knowledge of super-tension cable contract work, particularly on oil-filled cables, would be a considerable advantage.

Apply, stating age, qualifications and experience, to **Box No. 2523, Electrical Times.** (D 250p)

SENIOR DESIGN ENGINEER required by well-known manufacturers of Rotating Dynamo Electric Machinery. This is a senior Staff Position, and salary will be commensurate with the candidate's qualifications and experience, and will be not less than £900 per annum, as well as staff superannuation.—Reply to Box B.1146, W. H. Smith & Son, Ltd., Manchester 3. (D 179)

TECHNICAL ASSISTANT required for Sales Department of electrical instrument company in the West London area. Age about 25. Higher National Certificate. —Write, giving particulars of education, experience and salary required, Box No. 2555, Electrical Times. (D 343)

TECHNICAL SALES REPRESENTATIVE required (aged 30-40 years) for London area by electrical engineers with head office in north-east England. Applicants must have knowledge of electro magnetic applications and be experienced in sales representation.—Write, giving full details, to Box No. 2515, Electrical Times. (D 246)

THE ENGLISH ELECTRIC CO. LTD. at Stafford offer good opportunities for YOUNG ENGINEERS interested in relay and meter design. Qualifications: degree in electrical engineering or equivalent. Previous experience desirable but not essential. Facilities exist for giving successful applicants a thorough education in meter and relay design. Unusually pleasant working conditions.—Please write, giving full details and quoting ref. 406G to Central Personnel Services, Marconi House, 336-7 Strand, London W.C.2. (D 266)

THE NATIONAL BOILER AND GENERAL INSURANCE CO., LTD., St. Mary's Parsonage, Manchester 3, require ENGINEERS for appointment as Inspecting Engineers of (a) Boilers and Engines, (b) Lifts and Cranes, and (c) Electrical Plant. First-class M.O.T. certificate of competency, and/or Higher National Certificate (Mechanical or Electrical), full apprenticeship and practical experience necessary.—Apply in own handwriting, giving age (limits 26 to 33), training and experience, academic qualifications and copies of testimonials. Salary £540 to £785 (progressive). Non-contributory pension scheme. (D 327)

TOOL DESIGNER with first-class experience of modern methods and progressive tooling in press-shop and with knowledge of jig and fixture design required by leading manufacturer of light domestic and industrial switches and thermostats. Appointment would be of senior status and with prospects.—Write in confidence, giving full details of career to date and present salary to Box No. 2535, Electrical Times. (D 285)

VENNER LTD., require ELECTRICAL ENGINEER for development work on small generators. Degree or equivalent is essential. Salary in line with experience and qualifications.—Applications to Personnel Manager, Venner Ltd., New Malden, Surrey. (D 335)

WITH our business continually expanding, good opportunities are now occurring for REPRESENTATIVES in and around the London area. Knowledge of lighting and fluorescent equipment an advantage. Good salary and commission.—Write: S.A.M., Ekco-Ensign Electric, Ltd., 45 Essex Street, Strand, W.C.2. (D 328)

APPOINTMENTS WANTED

POSITION desired as SALES MANAGER or LONDON AREA MANAGER. 25 years in electrical industry. Rotating plant of all types with associated electrical equipment. Detailed experience of industrial applications, special drives, private generation, control and switchgear, installation, welding plant, etc. Apprenticeship and training with leading manufacturing company. Twelve years' experience as area manager.—Box No. 2503, Electrical Times. (D 197)

WORK WANTED

A.C. and d.c. MOTOR REWINDS and REPAIRS. Prompt service fully guaranteed. Edgware 5566 (4 lines). —Service Electric Co., Ltd., Stanmore, Middx. (D 15)

ARMATURE REWINDING SERVICE to the Trade. Vacuums, Drills, Grinders, Hood Dryers, Dental Motors, Vacuum Cleaner and Drill Armatures replaced from stock. 24-hour service. Every job guaranteed. All vacuum cleaner parts, hoses, etc., in stock for any make. —Regam Electric Cleaner Service, 95-97 Park Lane, Leeds 1. (D 297)

FISHER FOUNDRIES, LTD., Greet, Birmingham, have immediate capacity for machine moulded PRECISION CASTINGS in gunmetal and grey iron, ¼ to 30 lb. All castings shot blasted.—Telephone: Birmingham, Victoria 0197. (D 21)

METALWORK. All types cabinets, chassis, racks, etc., to your own specification.—Philpott's Metalworks Ltd., Chapman Street, Loughborough. (D 120)

WORK WANTED. Capacity available for all types of COIL WINDING.—Box No. 2425, Electrical Times. (D 36)

WANTED

A.C.-D.C. MOTORS, STARTERS, complete change-over installations, etc.—A.A. Electrical Co., Ltd., 67 Rothschild Road, Chiswick Park, W.4. Tel.: Chiswick 5105. (D 9)

WANTED, D.C. and A.C. ball-bearing MOTORS, MOTOR GENERATOR SETS, DYNAMOS and ALTERNATORS.—Full details to Britannia Manufacturing Co., Ltd., 22-26 Britannia Walk, London N.1. (D 5)

WANTED for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of secondhand machinery and plant for re-use.—W. and H. Cooper, Ltd., 176 Brady Street, Bethnal Green, E.1. (D 1)

WANTED. Large quantity of 4-in. outwide diameter TUBES from the dismantling of old Babcock water tube boilers. Best prices paid. Prepared to purchase Babcock and Wilcox water tube boilers for dismantling. —Apply, giving full details to Midland Iron and Hardware Co., Cradley Heath, Staffs. (D 2)

WANTED, ROTARY CONVERTERS, any size.—Universal, 221 City Road, London E.C.1. (D 7)

AGENCIES

COMMISSION AGENTS wanted, calling on wholesalers. Eastern and southern areas available. Wrought iron lighting fittings, health lamps, ships' fittings, conduit fittings. Please give full information in confidence, and state area covered.—Box No. 2401, Electrical Times. (D 29)

GRUBB ENGINEERING CO., LTD., Birmingham 12, require the services of reliable AGENTS for the areas of Yorks, Northumberland and Durham, S.E. Coast and the Midlands. Appliances include immersion heaters, oil radiators, electric fires and boiling rings. Live house accounts will be available to suitable applicants who must furnish excellent references and are already well connected with the electrical trade. (D 336)

BUSINESS OPPORTUNITIES

SALE OF WORLD-WIDE PATENTS IMPROVING DISTANCE OF POWER TRANSMISSION

AN Assignee is required for important patents in several countries—some already taken out. One of the great generator, transformer or switchgear builders is invited to become Assignee for an invention of extreme importance covering the placing of large contracts in certain countries. Apply:

TAYLOR,
Melyd Avenue, Prestatyn, Wales. (D 329p)

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C.M.A. surplus paper CABLES of every description. New and guaranteed, for immediate delivery at very competitive prices. Send for stock list.—E. M. Tatton and Co., Ltd., Electrical Engineers, Kew Bridge, Brentford. EALing 3155/6. (D 338)

D.C.C. WIRE 10 gauge, 4 tons unpacked on maker's reels, offered at 10% below maker's price.—Max Arc and Electrics, Ltd., Terrace Road, Walton-on-Thames, Surrey. Tel.: Walton 2497. (D 330)

DOMESTIC APPLIANCES

FOR SALE: Six "Sadia" electrical Water HEATERS, type C, 12 gallon. Five "Sadia" electrical Water HEATERS, Type H, 3 gallon.

Tenders for all or part to Director of Housing, City Hall, Charing Cross Road, W.C.2, by April 17, 1953.

The Council does not bind itself to accept the highest or any tender. (D 317)

ENGINEERING PLANT & MATERIALS

FOR SALE, one Cincinnati double housing all-electric PLANING MACHINE. Capacity 3 ft. by 3 ft. by 9 ft. Lancashire Dynamo drive for 400-440/3/50 supply. Machine of wartime manufacture, in excellent condition.—Robt. Cort and Son, Ltd., Reading Bridge Ironworks, Reading. (D 298)

ONE 170 b.h.p. PRODUCER GAS ENGINE, new 1924, by Ruston and Hornsby, direct-coupled to 100 kW generator by Crompton. In good running order.—Wm. Brown and Co. (Ipswich), Ltd., Grey Friars Road, Ipswich. (D 339)

GENERATING PLANT

MOTOR GENERATOR SETS, control panels, built to individual requirements. Good deliveries at competitive prices. All equipment guaranteed.—Thos. W. Ward Ltd., Albion Works, Sheffield. Tel. 26311 (ext. 347). (D 204)

SEVERAL Caterpillar D.8 engine GENERATING SETS on skids. 230/440 a.c.—Box No. 2539, Electrical Times. (D 300)

STEAM-DRIVEN GENERATING SETS. 665 kVA (500 kW) steam-driven Alternator Set by BELLISS AND MORCOM/SIEMENS, for 5,000/3/50, 77 amps. Steam pressure 150/155 lb. Speed 333 r.p.m.

250 kVA steam-driven Alternator Set by BELLISS AND MORCOM/HARLAND, for 400/3/50, 360 amps., 0.8 p.f. Steam pressure 140 lb., 12 lb. back pressure.

250 kW Geared Turbo Generator Set by BELLISS AND MORCOM/CROMPTON PARKINSON, for 207/230 V D.C. Speed 1,000 r.p.m. through reduction gear. Multi-stage Turbine designed for steam at 290 lb., 350° F superheat plus 25% overload for two hours when running at 6,000 r.p.m.

75 kW (94 kVA) steam-driven Alternator Set by BROWETT LINDLEY—B.T.H., for 400/440/3/50, 4-wire. Speed 5,000 r.p.m. Steam pressure 140 lb. sq. in. condensing.

George Cohen, Sons and Co., Ltd., Wood Lane, London W.12 (Tel.: Shepherds Bush 2070) and Stanningley, near Leeds (Tel.: Pudsey 2241). (D 264)

3.3 kW LIGHTING SET, 110 V with panel. 6 h.p. diesel Lister engine, 55 cells chloride; 2 years old. —W. M. Walker and Son, Electrical Eng., Tynedale Gardens, Stocksfield. (D 299)

18 kW Gardner GENERATING SETS on 2-wheel trailers. Hardly used.—Box No. 2541, Electrical Times. (D 301)

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PURLEY CHOKES AND BALLASTS. Our 80 W tapped h.p.f. ballast, with starter switchgear-holder incorporated, is proving itself the most popular unit. Suitable for most fittings, 57s. 6d. each subject.—F. W. Blanshard, Ltd. (Dept. E. T.), Purley, Surrey. Uplands 4618-8. (D 16)

METERS

A.C/D.C. QUARTERLY and SLOT METERS.—Brent Electrical Co., 6 Holmdale Gardens, London N.W.4. (D 6)

HOUSE-SERVICE METERS, a.c. or d.c., quarterly or prepayment.—Universal Electrical, 221 City Road, London E.C.1. (D 11)

METERS, a.c. and d.c., new and reconditioned, all types. Quarterly, single and three-phase, 3 and 4-wire, ½ to 1,000 amps. Prepayment, single and double tariff, single, dual and triple coin, fixed and variable tariff, ½ to 50 amps. M.D.I. Billiard Switches, Rent Collectors. Prices from 5s. carriage paid. Guaranteed for ever. Immediate delivery.—Illustrated catalogue from The Electric Meter Company, Dept. 46, Castle Circus House, Torquay. (D 201)

SWITCHGEAR

MERCURY SWITCHES are made by Hall, Drysdale and Co., Ltd., of 58 Commerce Road, Wood Green, London, N.22. Tel.: Bow 7221. (D 12)

MOTORS & STARTERS

A.A. ELECTRICAL CO. for A.C./D.C. MOTORS SWITCHGEAR, EXHAUST FANS, HOISTS, REDUCTION GEARS, new or reconditioned units.—Chiswick 5104. Chiswick 5605, 67 Rothschild Road, W.4. (D 8)

A.C. and D.C. MOTORS, all sizes, large stocks. Fully guaranteed.—Milo Engineering Works Ltd., Milo Road, East Dulwich, S.E.22. (Forest Hill 2278-9.) (D 4)

A.C. and D.C. MOTORS, GENERATORS, from stock.—Service Electric Co., Ltd., Honeypot Lane, Stanmore, Middx. Edgware 5568-9. (D 10)

FOR ELECTRICAL MOTORS, GENERATORS, ALTERNATORS, SWITCHGEAR, please send your inquiries to Oldfield Engineering Co., Ltd., 96 East Ordsall Lane, Salford 5. (D 13)

GEARED MOTORS, new, in stock. From 1 r.p.m. to 4 h.p. spur or worm gears by well-known makers.—Super Power Ltd., 81 North Side, Clapham Common, S.W.4. Battersea 3355. (D 183)

NEW A.C. MOTORS FROM STOCK: ⅓ to 200 h.p., 400 V 3 phase, 50 cycles at 600, 750, 1,000 and 1,500 r.p.m. Immediate despatch, competitive prices.—Thos. W. Ward Ltd., Albion Works, Sheffield. Tel. 26311 (ext. 347). (D 203)

45 h.p. Crom. Park SLIP RING MOTOR, 400/440 V, 3 ph 50 cyc. 950 r.p.m. S/Pro. B.B. recon. and guaranteed. With new E.A.C. oil imm. starter. Price £200.

35 h.p. DITTO but 720 r.p.m. Recon. and guaranteed. With new E.A.C. oil imm. starter. Price £192.—Super Power Ltd., 81 North Side, S.W.4. BATtersea 3355. (D 256)

All types and sizes of

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ELECTROPOWER COMPANY LIMITED

Kingsbury Works, Kingsbury Road, London N.W.9. Telephone: COLindale 4621/2. (D 14p)

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A.C. and D.C. MOTORS, DIESEL ALTERNATOR SETS, GENERATORS, TRANSFORMERS, WELDERS, PLATING PLANT, CONTROL GEAR, SWITCHGEAR, PORTABLE TOOLS, etc. Stock list post free.—Thos. W. Ward Ltd., Albion Works, Sheffield. Tel. 26311 (ext. 347.) (D 202)

HIGH VACUUM IMPREGNATORS for £280. Suitable for all impregnation requirements. Other specialised vacuum equipment manufactured to customers' specifications.—Vactite Components and Assemblies, 505 Lordship Lane, S.E.22. Tel.: Forest Hill 7089. (D 302)

THREE Units comprising: 2 h.p. Crompton Parkinson Motor, 400/440 V, 3-phase, 50 cycles, 1,400 r.p.m. Mounted on 500-1 Reduction Unit. V belt drive. Complete with control box.—Maden and McKee Ltd., 317 Prescot Road, Liverpool 13. (D 306)

MISCELLANEOUS

CITY AND GUILDS (Electrical, etc.) on "No Pass—No Fee" terms. Over 85 per cent. successes.—For full details of modern courses in all branches of Electrical Technology send for our 144-page handbook. FREE and post free.—B.I.E.T. (Dept. 39), 17 Stratford Place, London W.1. (D 19)

FREE! Brochure giving details of courses in ELECTRICAL ENGINEERING and ELECTRONICS, covering A.M.Brit.I.R.E., City and Guilds, etc. Train with the Postal Training College operated by an Industrial Organisation. Moderate fees.—E.M.I. Institutes, Postal Division, Dept. ET.29, 43 Grove Park Road, London W.4. (Associate of H.M.V.) (D 20)

TAVISTOCK REPERTORY COMPANY (non professional) of the Tower Theatre, Canonbury, require Honorary ELECTRICIAN interested in stage lighting to assist with choke-dimmer switchboard in their new theatre. Frequent productions. Honorary Membership.—Write to Hon. Director, T.R.C., Canonbury Tower, Canonbury Place, Islington, N.1. (D 303)

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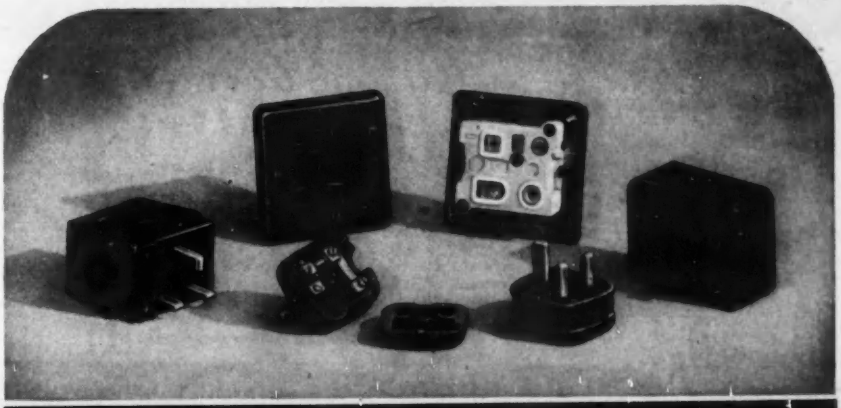

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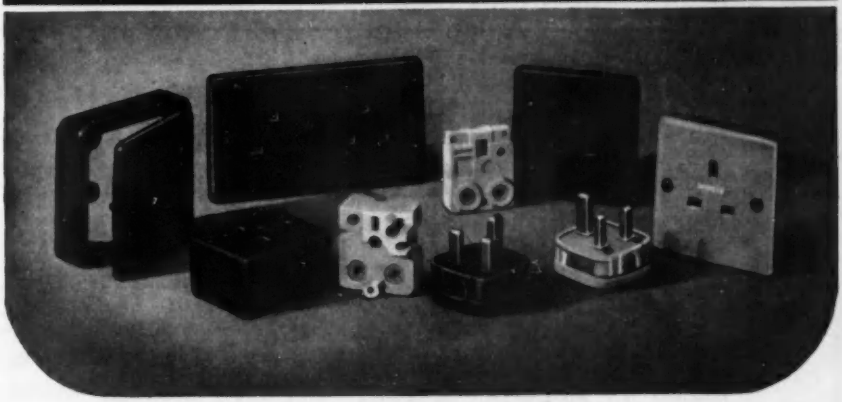

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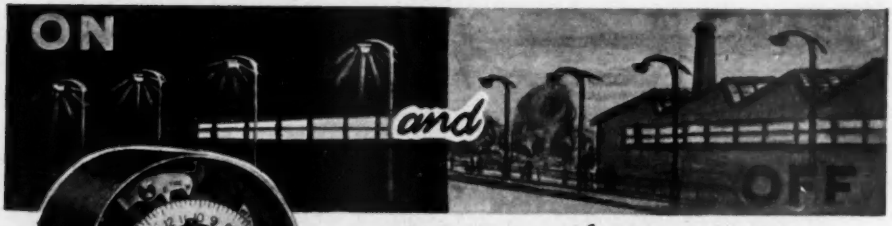

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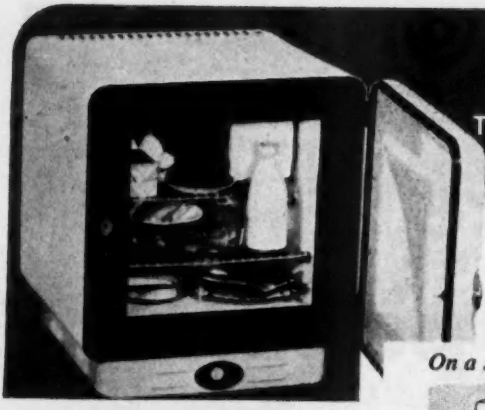

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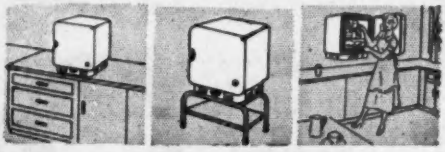

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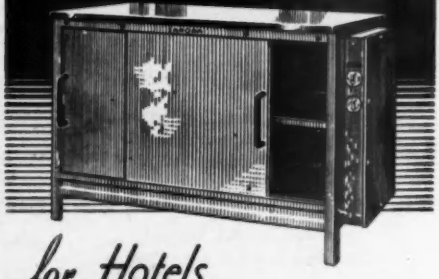

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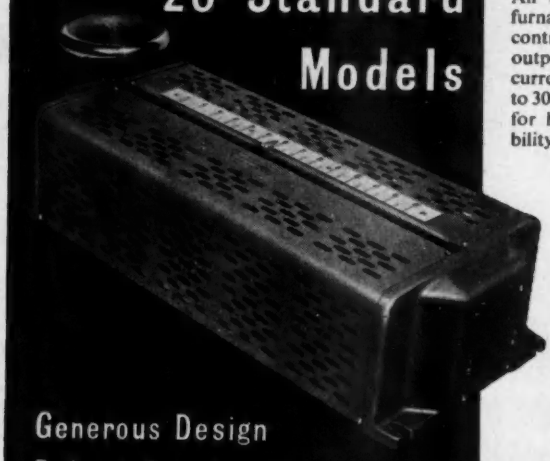

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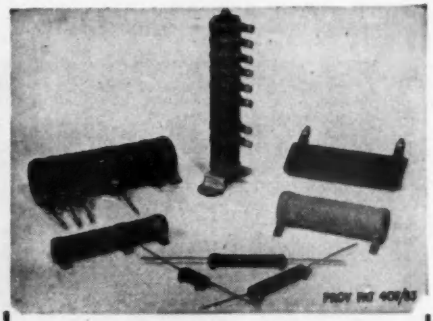

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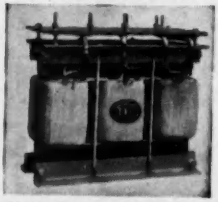

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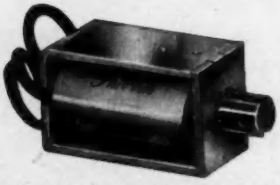

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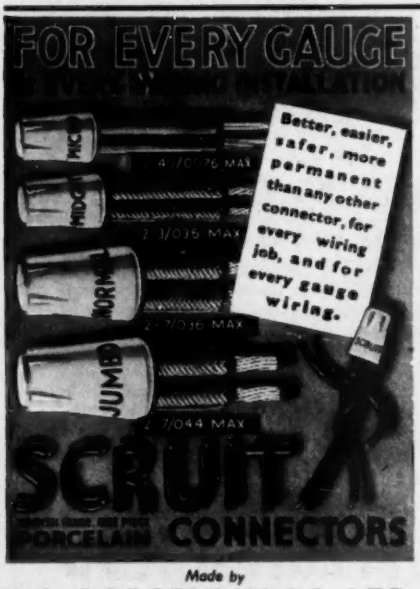

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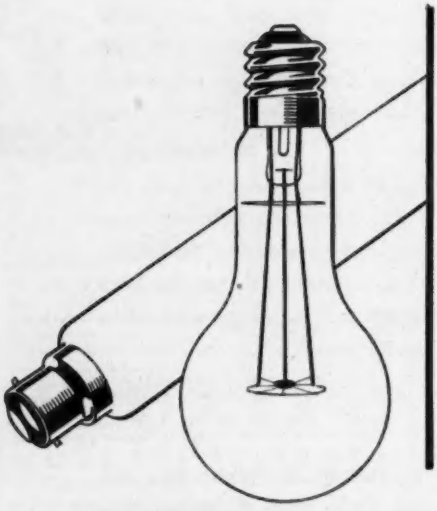

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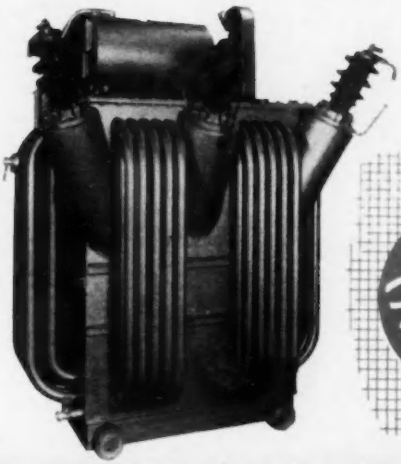

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